POWER

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Shorter Days or Fewer Years?

THE USE of power-driven machinery has so increased the productivity of human labor that it is coming to be a question what we shall do with our man-power.

Benjamin Franklin figured that if every able-bodied man worked four or five hours a day the race could be supported on the plane on which it was then living.

The luxuries of his time are the commonplaces of the present, and the laborer of today enjoys advantages of which his generation never dreamed.

We have been able to increase the buying power of the people so far that they can absorb their own increased production, but there is a limit, and still shorter working days and a five-day week are being urged as preventives of increasing unemployment.

In order to support a people upon a given plane, a certain amount of work must be done. With a given number of workers available each must contribute a certain number of work-hours to pay for his living and that of those dependent upon him.

If he works five hours a day instead of eight he will have to work eight-fifths as many years.

Would it not be better if he continued to work the present number of hours per day for an equivalent shorter number of years?

His aggregate pay, if proportional to the time served, would be the same in either case. By working the longer hours in his more active years he would have it all earned before he reached an age when his efficiency was diminished, opportunity lessened, health impaired and labor a burden.

The extra money earned by thus concentrating his labor to his productive years, wisely invested, would permit him to retire while yet able to enjoy life, making place for another with assured support for his declining years.

At the end of a reasonably long life he would have worked no more hours then he would have with the shorter days for more years and would be independent and comfortable at the harder end.

And the collective extra earnings of labor, so invested, would be sufficient to acquire and control the tools of industry.

F. R. Low

POWER *Stands for . . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application

Do Not Stress the Minor and Neglect the Major

IN THE safe operation of elevators, conditions of the ropes have been given a great deal of attention. This feature has probably been overemphasized to the neglect of other parts. The number of serious elevator accidents due to rope failures is practically negligible. This cannot be said of the elevator accidents from other causes in those states that have not adopted adequate safety laws.

About ninety per cent of all accidents occur at the landings. Notwithstanding this condition, it is not uncommon to find great emphasis placed on the condition of the ropes, while devices for making elevators safe at the landing are neglected. If elevators are to be made practically one hundred per cent safe, which they can be, the place to attack the problem is where accidents are most likely to occur, namely, at the landing doors.

Breaking of a hoisting cable is objectionable, although not necessarily serious. On traction elevators there are usually six hoisting cables. Rarely has more than one of these ropes failed at a time. The chief objection to a rope breaking is the excitement it may create among the passengers in the car and the necessity of taking the car out of service when it may be badly needed. Seldom have passengers been seriously injured from this cause. If the governor and safety equipment are in good working condition, even if the hoisting ropes fail and thus release the car, the safeties will be set and prevent its falling. In other words, insofar as the the cables are concerned, there is a second line of safety to prevent a serious accident if the hoisting ropes fail.

It would be considered criminal negligence in any state to install and operate elevators without safety governors. Interlocks on the landing doors would probably prevent ten accidents to every one by the governor, yet four states have seen fit to make mandatory the installation of landing-door and car-gate interlocks. In the states where such interlocks are required on all elevators, serious accidents to passengers seldom occur, except when the safety devices have been neglected. Even under this condition accidents are of infrequent occurrence.

A Fuel Oil Standard Seems Possible

WHILE the national meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers at Pennsylvania State College was the avenue whereby several notable papers on oil engines were presented to the engineering public, the outstanding achievement was the announcement of the tentative fuel oil specifications.

Last year the national meeting petitioned the parent society to appoint a research subcommittee on fuel-oil specifications. This was promptly done and the members of the committee were chosen from engine builders, oil refiners and oil-engine users. Without delay the committee proceeded to examine the whole Diesel fuel-oil situation.

Predictions were freely made that no good could come out of a committee whose members represented such divergent, and even opposing, interests. Few believed that builders would be frank in acknowledging the limitations of their engines in burning poor fuels. And, but an equal number could persuade themselves that the oil refiners would get together and acknowledge that after all some oils sent out were impossible of use in any engine.

In spite of all this multitude of doubting Thomases, the committee was able to draw up a preliminary specification that was agreeable to the refiners and to the engine builders. Each party to the movement was willing to concede something. The builders admitted the increase in sulphur content and were willing to forget practically all requirements beyond the viscosity, Conradson test, ash and water. The refiners were agreeable to a closer processing with a view of obtaining a better and more uniform fuel.

Of course, this preliminary specification may be rebuilt after it has been tried out in a number of plants, but it supplies a ground work upon which to construct a practical fuel oil specification. When the so-called No. 1 specification is adopted for slow-speed engines, the No. 2, on light fuel for high-speed engines will next receive attention.

The Oil and Gas Power Division is to be congratulated on its bravery in attacking the problem and the subcommittee upon its solution.

Why Discard the Proved

ALONG with the Government's expressed determination to get out of the shipping business, through disposal of the emergency fleet to private interests, there appears to be a disposition in Washington to go the whole way and shortly dispense with the one department that has justified its existence many fold, through the savings it has effected. This is the Fuel Conservation Section, made up of a small group of engineers who, through constructive advice and technical control, have year by year improved the performance of the ships and

progressively reduced their fuel consumption. During the last twelve months the savings in fuel alone over the preceding year amounted to ten times the cost of maintaining the section.

The Government has lately embarked upon an extensive program for aiding agriculture that will draw heavily upon the Treasury. Through unstinting support of the Department of Commerce it has made that bureau a great tool of industry. It is prepared to sacrifice millions through disposal of the ships at a fraction of their cost, and is providing long-term credits in an effort to establish a privately owned merchant marine. Yet, it apparently balks at the expenditure of a paltry fifty thousand a year in extending to the new owners, many of them new in the shipping business, the accumulated experience of this staff of technical experts. Moreover, it is understood that many of the companies would welcome such assistance; in fact, some have already taken advantage of it, with most gratifying results as measured by their fuel bills.

Aside from the matter of fuel conservation, the value of such a service is apparent when one considers the many handicaps to operation under the American flag in competition with foreign ships and the fact that economy in the engineering department of a ship may mean the difference between profit and loss.

Retention of this service is not incompatible with the Government's policy of getting out of the shipping business. Perhaps it has simply been overlooked in the general order to "scuttle ship."

Feed Water for Small Plants

THE feed-water problem of the small boiler plant is like the common cold—everybody suffers from it, but no one does much about it. Large power plants go to great lengths to insure a pure and air-free feed to their boilers. Smaller establishments generally hesitate to incur so much expense.

However, now that many plants of relatively small size are going to high pressures, the problem demands serious consideration. As the temperature of the water in a boiler operating at such pressure is from four hundred and fifty to five hundred and fifty degrees Fahrenheit, the solubility of scale-forming substances contained in it is so low that the amount of these materials that may be tolerated is greatly reduced as compared to what is permissible at the lower pressures generally employed a few years ago.

In view of this, it becomes necessary for plant owners and designers to revise their ideas as to what may be spent for feed-water conditioning in the small plant. There is a balance between first cost and operation and maintenance costs that gives the lowest overall expense. With each increase in pressure this balance point changes. Its position should be carefully determined for all new installations, particularly as to the amount advisable to invest in feed-water-treating equipment.

Is the Bird-in-Hand Worth Two in the Bush?

A DOLLAR of immediate profit too often outweighs other gains that are less apparent. Men are so concerned with today that they tend to disregard the future. When the Persian poet said, "Take the cash and let the credit go," he spoke for many modern industrialists.

These remarks are called forth by the attitude exhibited by some small industrial plants toward the elimination of smoke. Experience indicates that hand firing is almost sure to be accompanied by periods of objectionable smoking. The installation of some method of mechanical firing such as a stoker makes it possible to avoid this smoking. But, in some localities where wages are low, this means an increase in costs due to the higher fixed charges. So the change is not made and the smoke nuisance goes on.

Of course there are many other sources of smoke, but that is no valid excuse for the industrial plant waiting until others mend their ways before it acts. And smoke elimination will bring returns that will, in a comparatively short time, more than offset the investment required.

For instance, over any considerable period even the small sizes of industrial stokers here referred to will save coal and will increase average boiler efficiency. Though their use may save little or no labor and add to the fixed charges, it pays in the long run. There are two birds in the bush of smoke abatement—improved conditions for the plant's neighbors and lower power costs. There is profit in going after them.

Beauty and the Power House

THERE was a time when champions of things artistic sniffed through contemptuous, upturned noses at the handiwork of "grimy engineers"; a time when the power house was regarded as a symbol of a crude industrial regime bent upon destroying the beautiful with dirt and smoke and rasping din. That time is past, and both the engineer and the artist have had a part in changing it.

The hands of the engineer are no longer grimy; for he has learned that grime is the symbol of inefficiency. He has learned that the blackened walls, the smoke, the din of metal pounding harshly upon metal, and the oily puddles underfoot are worthy of contempt only, because they are symbols of wasted energy.

And the defender of beauty has changed. He is no longer contemptuous; he writes about dynamos, and novels of the unceasing struggle to free man from the slavery of manual labor by harnessing in his stead the untiring forces of nature.

Thus there has been a meeting of the minds; and engineer and artist, hand in hand, may glory in the flash of bright metal, may thrill to the singing monotone of shafts running true, and may stand in awe of that spark within the mind of man that has given him this mighty power.

Flexible Central Plant Serves Large Greenhouse

Savings are effected in coal and labor by replacing four individual hand-fired plants with one central plant burning pulverized coal and supplying varying steam demand. Features are special short-flame burners and dust-collecting breeching. All auxiliaries are steam driven, the economy of the plant being enhanced by using the exhaust steam for heating the greenhouse

GROWING cucumbers out of season under glass, with the required moisture and heat supplied artificially and maintained uniformly, has become a profitable business. Ordinarily, this out-of-season growing begins about Nov. 1 and continues for nine months of the year. During this period steam is needed to maintain a temperature of 70 deg. in the greenhouse and to heat water to the same temperature for spraying the crop. The demand on the plant is variable in the extreme, depending upon the vagaries of the sun and the wind. When Old Sol is in a liberal mood the requirements are at a low ebb, as much of the needed heat is obtained by trapping his rays under the glass. The minute his face is obscured, however, there is a sudden and urgent need of steam, so that within a half-hour operation of the boiler plant may swing from practically a banked condition to 200 to 300 per cent rating. These sudden variations may occur many times during the day, since, in addition to the sun's rays, wind and outside temperatures are factors having a bearing on the demand. It is evident, then, that one of the first essentials of a boiler plant in this business is flexibility.

For the foregoing reason and with the expectation of being able to burn cheaper grades of coal at high efficiency, the Kay-Bee Company, specialists in hothouse cucumbers, decided to install a central pulverized-coal boiler house at the Morrison, Ill., plant of the company, when it became necessary to replace four individual heating plants. At the Morrison establishment, which is one of three operated by the company, the growing area un-

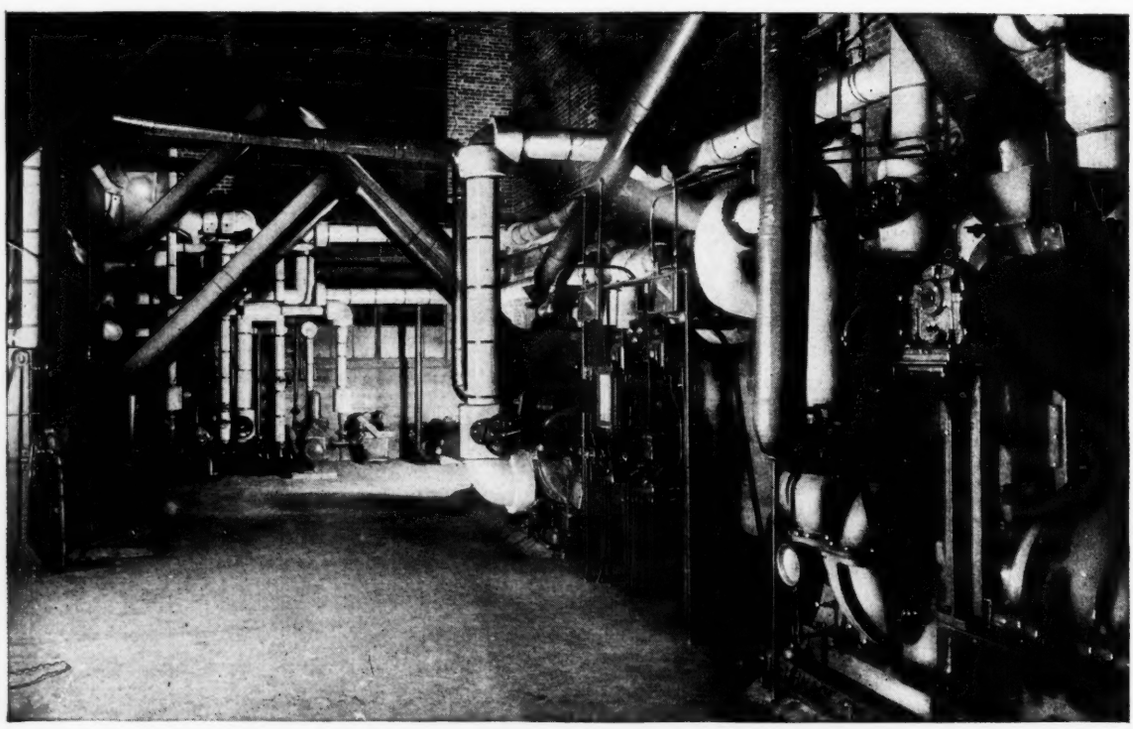


Fig. 1—Interior of boiler house, showing pulverizers at right and boilers at left

der glass totals 260,000 sq.ft. This area is divided into four ranges, and in each return-tubular boiler installations of two and three units, aggregating ten boilers in all, hand-fired and operating at 60-lb. pressure, had been used to supply the steam for heating. Some of these boilers had been in service for twenty years; the plants had run down; and in the colder weather sufficient steam could not be supplied to maintain the desired temperature of 70 deg. F. over the entire growing area. New equipment of greater capacity was needed, so it was decided to install a central plant serving all four ranges that would economize in fuel and labor, and by equipping it for the burning of pulverized coal insure the flexibility desirable in meeting a greenhouse load.

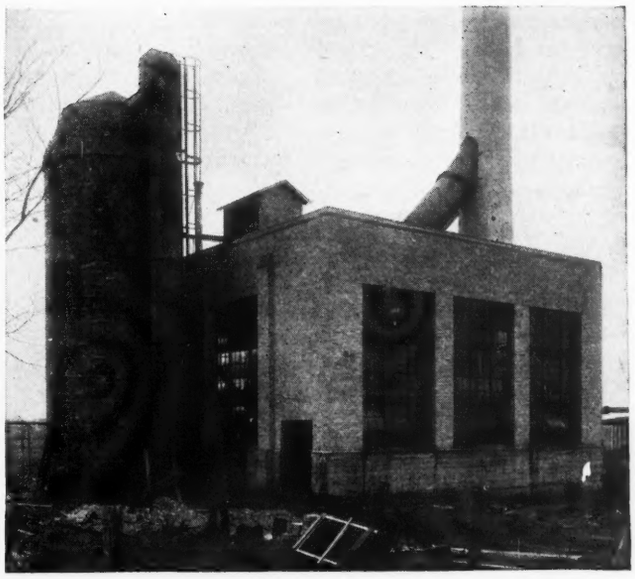
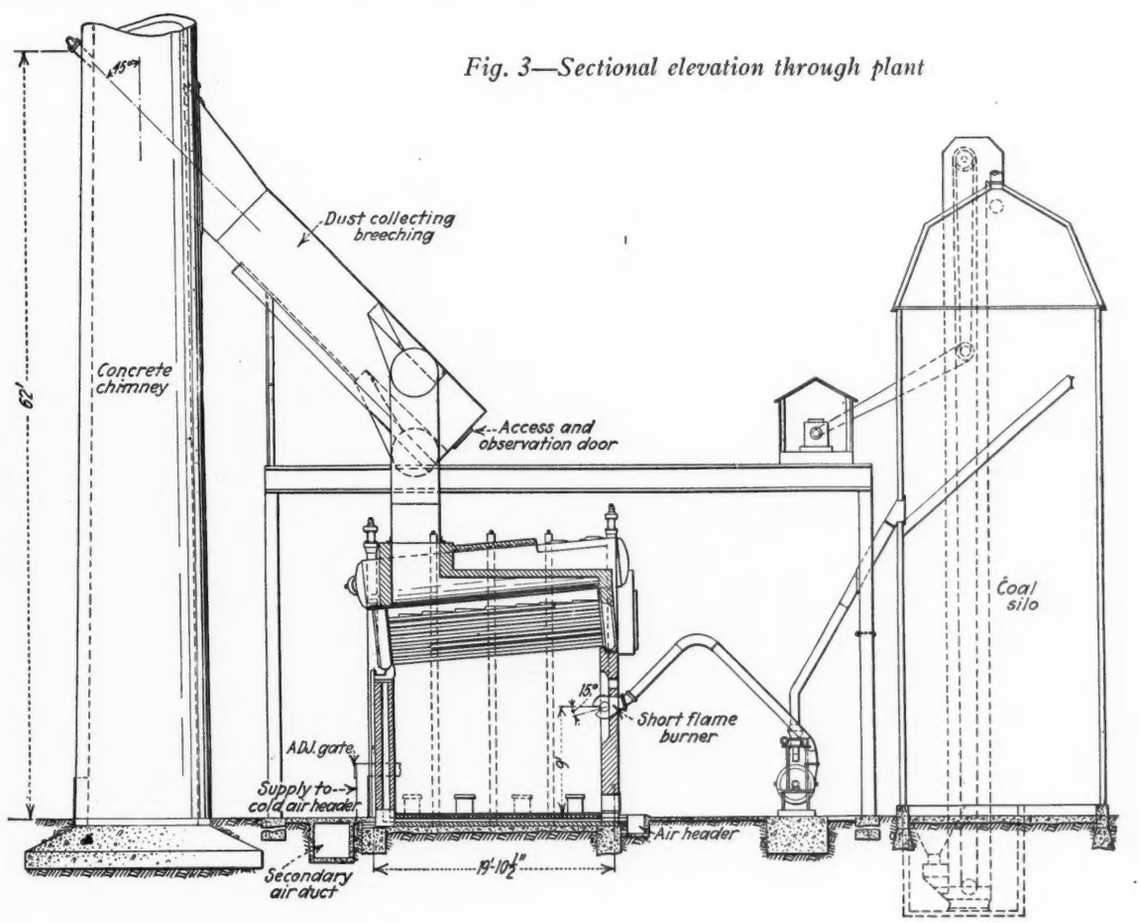


Fig. 2—Central boiler house of the Kay-Bee Company at Morrison, Ill.

In a modern brick and steel building measuring 59 ft. wide, 49 ft. long and 26 ft. 6 in. from the floor to the bottom of a flat, built-up roof, two boilers were installed, each having 3,060 sq.ft. of heating surface. These boilers are of the single-drum Heine type, horizontally baffled, with the first three rows of tubes exposed to the fire. The boilers are set 13 ft. 6 in. above the floor at the front end, and from the floor to the bottom of the rear water leg the headroom is 12 ft., giving a furnace volume approximating 1,980 cu.ft., which reduces to 0.65 cu.ft. per sq.ft. of heating surface. See Figs. 1 to 4.

The furnace is provided with air-cooled walls and floor. The walls are made up of Furnace Economy Company's blocks with hollow stream-line center sections, backed by 4½ in. of rock wool insulation and a steel casing. These blocks in alternate rows, are staggered to form tortuous vertical passages through which the secondary combustion air passes from bottom to top, and in the process is preheated 300 to 400 deg. F., depending upon the rate of operation. The air-cooled area of the furnace totals 400 sq.ft. and the heat-dissipating surface of the blocks 1,200 sq.ft. The heat liberation at 250 per cent rating is 16,300 B.t.u. per cu.ft. The floor of the furnace is made up of 2x12x12-in. shiplap tile laid on firebrick sleepers, two high, to form the air space, below which are firebrick on edge resting on an 8-in. concrete slab.

Fig. 3—Sectional elevation through plant



Each boiler is served by a Simplex mill, having capacity to pulverize 3,140 lb. of coal per hour. The drive is a 40-hp. Standard turbine making 1,800 r.p.m. and at full load exhausting at 18 lb. back pressure into the exhaust-steam main, which conducts the available supply from the plant to the nearest ranges, where it is utilized as far as it will go for heating. This economical use of exhaust steam minimizes the cost of grinding and of the other power requirements.

A useful auxiliary to the pulverizer is a direct-connected 1-kw. generator that energizes the magnetic separator on the coal supply and generates the current to drive the feeder motor.

Primary air for combustion enters at the top of the rear wall of the setting, passes downward through the hollow blocks, then through the air space under the furnace floor and reaches the pulverizer fans at a temperature of 200 to 350 deg., depending upon the rate of operation.

Secondary air is drawn into the building by a forced-draft fan of 7,000 cu.ft. per min. capacity driven by a 7-hp. Dake engine. To prevent collection of ice in extreme cold weather, two banks of Vento sections are set in the intake of the fan, so that the exhaust from the engine may preheat the air when the load is at a maximum and there is the greatest need for it, owing to the weather. In mild weather the air is drawn in by natural draft. The air flows through a 3x3-ft. duct under the floor at the rear of the boilers and up through metal headers, delivering to the furnace side walls. Adjustable gates in the headers are provided to control the air quantities. In its passage up through the walls the air is preheated to 400 deg. F., collected at the top and introduced into the furnace through secondary air ports in the side walls at the front of the furnace and on a level with the burner. Of the air for combustion, about 40 per cent is primary and 60 per cent secondary.

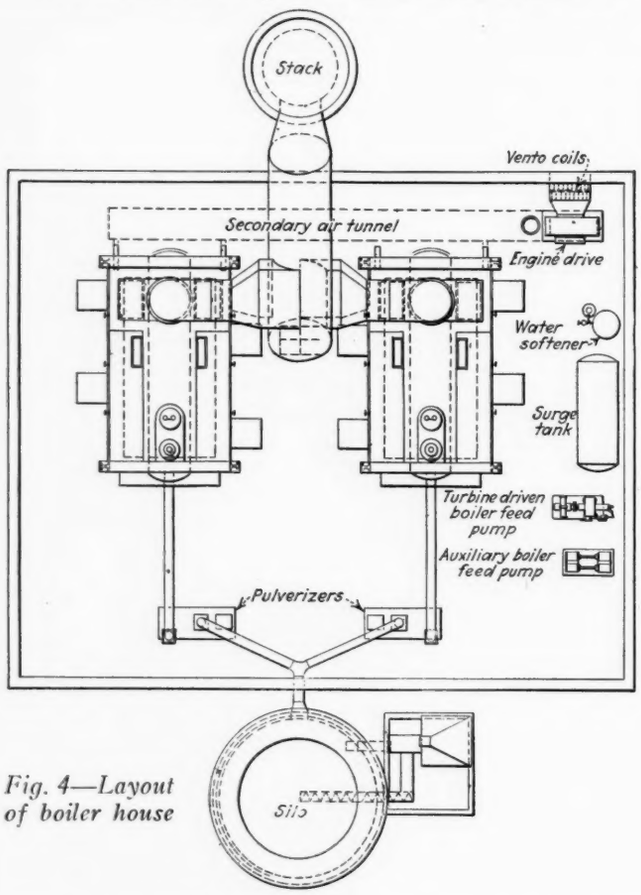


Fig. 4—Layout of boiler house

One of the features in the plant is a short-flame burner, shown in Fig. 5, which is built on the principle of the old two-prong acetylene gas tip. The two passages are formed around a circular throat, and the nozzles at the nose of the burner project streams of fuel and air obliquely against each other to produce a fan-shaped spray perpendicular to the plane in which the two passages lie, or, in other words, a flame parallel to the bottom of the furnace. The length of the flame is controlled by the shaping of the nose pieces, so that for each installation it is possible to design a burner that will hold the flame to a carefully controlled path and keep both flame and slag away from the refractories of the furnace.

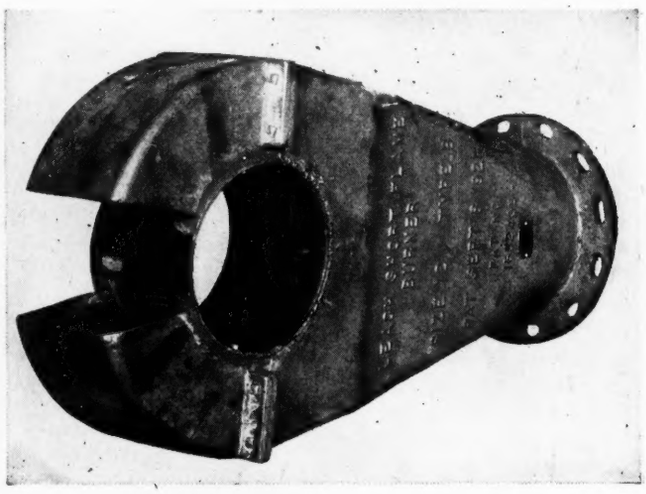


Fig. 5—Leach short-flame burner

How Short-Flame Combustion Is Attained

Relatively short-flame combustion is attained, first, by high-nozzle velocity, which guards against backward projection of the flame into the feeder line, and, second, by the mutual impingement of the jets, spreading the entering air and fuel over a wide area, so that their forward velocity is greatly reduced. In this way the benefits of a low-velocity burner, with the safety margin of a high-velocity burner, are obtained.

Owing to the burner design, the flame does not increase in size in proportion to the load but rather increases in intensity. At minimum load the pressure may be just sufficient to keep the coal particles floating in the currents of air, while for maximum capacity the air pressure has been run up as high as 15 in. of water. Flexibilities of 1 to 20 have been realized. Ordinarily, however, the pressure on the coal lines runs from 2 to 3 in. of work. Each boiler is equipped with a 10-in. burner.

Because of the large area of glass in the immediate vicinity of the boiler house, which must be kept clean and free of dust, so that the sun's rays may penetrate to the crop, it was important that the quantity of ash escaping to the atmosphere from a powdered-coal plant be reduced to a minimum. For this purpose a dust collecting breeching, designed by the consulting engineer, has proved to be most effective. After several months of operation there has been no collection of ash in the base of the stack, nor has ash appeared on the glass surfaces of the greenhouse.

As shown in Fig. 6, the breeching, which is circular in cross-section, is inclined at an angle of 45 deg. to the stack. An expansion joint in the transformation piece permits the stack to sway two inches either way, which might be possible under a wind velocity of 100 m.p.h. The chimney is of concrete, rising 152 ft. 6 in. above the base, and is six feet in diameter at the top.

Uptakes from the two boilers enter the breeching tangentially, from opposing sides, one at the top and one at the bottom, so that the gases flow in a spiral on their way to the chimney. Owing to this spiral motion the coarser particles of dust are thrown to the outer circumference of the breeching by centrifugal force, to be skimmed off by a raised plate passing longitudinally

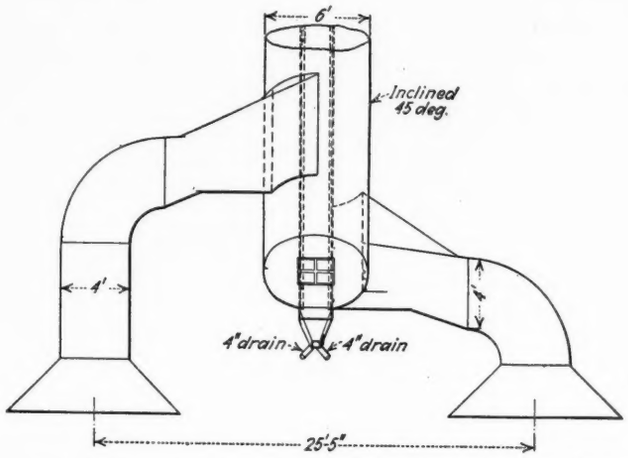


Fig. 6—Front elevation of uptakes and breeching

along the bottom of the breeching, into a trough through which the ashes slide back into a small bin at the lower end of the breeching. From this bin the ashes pass by gravity to storage.

With this construction of breeching fully 60 per cent of the ash carried in the gases has been collected at this point. The remainder of the ash that gets this far is so light that it floats up the chimney and is carried away from the plant.

In order that the action in the breeching may be visible to the operator in the boiler house, a light with a reflector has been placed on the far side of the chimney on the extended center line of the breeching. At the bottom end of the breeching is a glass window through which the operator, standing in the vicinity of the instrument board, can see the illuminated breeching interior for its full length, and from the same point he can see the instruments that indicate the operating conditions of the boilers. Mounted on this board, midway between the two pulverizers, there are steam-flow meters, draft gages, pressure gages on the burner lines, the rheostat controls for the feeder motors and the switch of the magnetic separator circuit.

Coal for the plant is delivered by trucks, which dump into a grill-covered hopper. By cross screw conveyors and a bucket elevator the coal is transferred from the hopper into a tile silo built by the B.-G. Construction Company, having a capacity of 225 tons. At the top of this silo is a 40-ton live storage bin, from which the coal is chuted by gravity to the pulverizers. If the delivery is greater than the consumption, the coal may overflow into the bottom of the silo, to be elevated again as needed into the live-storage bin by a bucket elevator. As with all the other auxiliaries of the plant, the elevator and conveyors are steam driven by a 7-hp. Dake engine, located in a doghouse on the roof of the boiler plant, with roller chain drive to the conveyors. This engine exhausts to the Vento coils.

City water is used in the plant, and, as it is hard, the makeup is passed through a zeolite softener of 2,000-gal. capacity. The returns from the ranges, amounting to about 90 per cent of the feed, are brought back to a special steam-sealed deaërating surge tank, mounted 12 ft. above the feed pumps in the boiler room. Owing to the use of tilting traps for this purpose, the temperature of the return water is maintained at 180 to 200 deg. F. Two feed pumps have been provided, one, a centrifugal, being driven at 3,450 r.p.m. by a 25-hp. turbine. The other is a duplex direct-acting pump. The exhaust from either of these units is utilized for heating.

Under Irwin McKee, superintendent of erection, the plant was built by day labor without an accident, and under him it was operated for a number of months until the present operators were thoroughly familiar with the routine. During the six months the new plant has been in operation the results have been most satisfactory. Considerably more steam has been supplied. The load has ranged from 5,000 to 35,000 lb. of steam per hour, and for much of the time it has been carried on one boiler. The steam is generated at 140-lb. pressure and conducted at this pressure through insulated pipe lines to the ranges, the longest line extending 500 ft. from the boiler house. At the ranges the pressure is reduced to a point that will give the desired temperature.

No Trouble Has Been Had from Slag

In the furnaces there has been no trouble from slag formation. It was found that as long as the ash was not over one inch thick on the floor and the proper quantity of air was passed through the spacing underneath, slag would not form even when the boilers were operated up to 300 per cent rating. To facilitate removal of the ash two clean-out doors were provided on each side in a staggered arrangement.

Up to the present the maintenance cost has been low. There has been no occasion for replacement of the blocks or other refractories in the setting walls. Maintenance costs of three to four cents per ton of coal have been charged to the mills for the renewing of liners, hammers, fan-discharge blades, etc.

As to actual economies the data are not complete. But this may be said: Owing to the exceptionally cold winter and the heating of additional space, calculations based on past operations at Morrison and at the other two plants of the company indicated that the coal consumption should have been 40 per cent greater than during previous seasons. As a matter of fact, from Nov. 1 to March 1 the coal consumption was 550 tons less than for corresponding periods in previous years, and instead of burning two-inch Illinois nut, the fuel has been No. 5 carbon, consisting principally of fine dust. In labor, 100 hours a day were saved, amounting, at 40c. an hour, to $40. Incidentally, a larger crop was produced, as there was plenty of steam to heat to the desired temperature all available growing space. The cost of the plant, including building, stack, piping, engineering and all equipment, was $66,000.

Combustion engineers of the Peabody Coal Company, Chicago, under the supervision of V. G. Leach, were responsible for the design of the plant, the burners and the dust-collecting breeching.

What the Power Engineer Can Do for

Brush Standards

By W. C. Kalb
Engineer
National Carbon Company

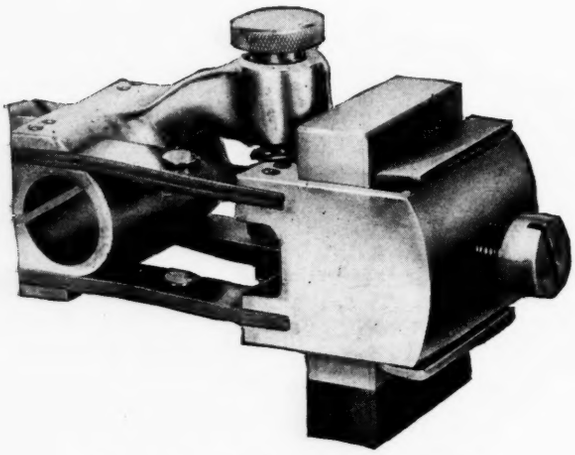


Fig. 1—Parallel-motion clamp-type brush-holder

One company has reduced the number of styles of brushes required on its motors from over 1,000 to 100 without making a change in brush-holders

FROM the two preceding articles on standardization of carbon brushes, June 11 and 25 numbers, it might appear that this is essentially a problem for the designing engineer of the electrical manufacturer and that results can be looked for only at some time in the future. Such is not the case. A great deal can be accomplished toward brush standardization by a careful analysis of the brush requirements on existing electrical equipment. As a first step in making such an analysis, it is well to enlist the co-operation of the brush manufacturers. Their engineers, by making a study of the operating characteristics of the motors and generators in the plant, can recommend the minimum number of grades necessary to insure satisfactory operation on the several types of electrical equipment. The co-operation of brush engineers will be of value in analyzing the points discussed in this article.

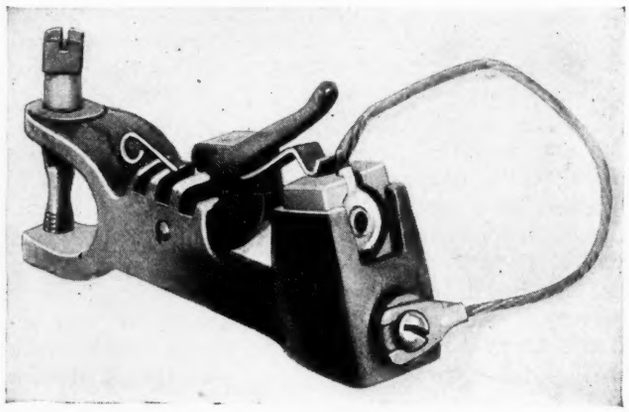
It is assumed that this analysis is to be worked out without the installation of new sizes or types of brush-holders. Instances may be uncovered, however, where such a course is evidently desirable and readily justifies the cost. This being the case, the selection of the brush-holder should be such that no additional variable is introduced on that account.

With existing brush-holders the width and thickness of brushes are probably fixed, leaving only the length subject to adjustment. Examination of all holders, taking a brush of given width and thickness, will probably disclose that one or two lengths at the most are all that will be required for that particular cross-section. If limits are to be specified on length, width and thickness, the tolerances should correspond to the recommendations of the committee on simplified practice as set forth in the first article of this series. This permits the use of standard box gages when inspecting the finished product.

The subject of bevels should next be given consideration. Undoubtedly, top bevels can either be eliminated or can be reduced to one bevel for any given size of brush. Face bevels probably can be reduced to three, depending upon the brush position. There are many types of brush-holders, some of which are rigidly mounted. But most of those found on industrial motors can be adjusted over a range of several degrees, thus permitting brushes of similar type to be adjusted to a uniform angle. Figs. 1 to 3 are representative of the types of holder used for the several brush positions. The first picture shows the familiar parallel-motion clamp-type holder, commonly operated with the brush in radial position. Fig. 2 is an example of the box-type holder, also used for brushes operating in the radial position and in more general use than any other type for brushes operated in the trailing position. Fig. 3 illustrates a reaction-type holder used for brushes operating in the leading position.

Definition of these three positions of operation is best given by a diagram and is shown in Fig. 5. Odd-face bevels, such as 5 deg. should be eliminated and brushes

Fig. 2—Box-type brush-holder



intended for radial operation should be purchased without bevel. A bevel of 15 deg. is the most satisfactory for average operation in the trailing position. While 30 to 37½ deg. are in common use for leading operation, 35 deg. has been recommended as standard and should prove satisfactory in practically all cases. In some instances it may be advisable to reverse the brush position where by so doing one bevel can be adopted for all brushes of a given grade and size

When the brushes are investigated, it will doubtless be found that many styles of shunt connections are in use, also odd lengths of shunt cable and a multiplicity of types and sizes of terminals. One or two styles of shunt connection probably will be found sufficient for every machine. Shunt position usually can be restricted to one location on all brushes corresponding in other details. Shunt length generally can be confined to two standards, 3½ and 5½ in. Cable sizes should be confined to one size for any given brush grade and cross-section. It may be found that the terminal screws on some of the brush-holders require different size terminals, whereas other details can be standardized. In such case it is worth while drilling out and retapping the smaller hole, or perhaps changing the location, permitting one type and size of terminal to be used on this particular style of brush.

It has been clearly demonstrated that the beneficial results of an analysis such as the foregoing are real and not theoretical. On one large property, over 1,000 styles of brushes were found in the storeroom. Without changing a brush-holder or rendering obsolete a brush gage his order point accordingly. The purchasing department can order by an item number, avoiding the long list of detailed specifications otherwise necessary. The brush manufacturer, holding detailed specifications for each item number, is able to manufacture the brushes accurately to the customer's order without delivery being delayed while awaiting particulars on some missing detail.

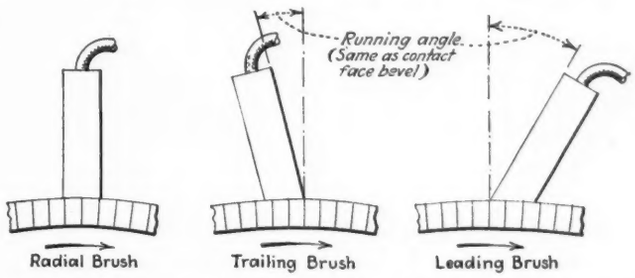


Fig. 5—Three positions in which brushes are operated

The many advantages to be realized by standardization of brushes justify careful study of this question by every industry operating any appreciable number of motors or generators. The cost of effecting this standardization is small and is more than compensated by the saving in brush expense and cost of maintaining brush stores, as well as by the elimination of delays and inconveniences caused by error or omission in specifications. The major cause of delay in filling brush orders at present lies in the fact that each item must

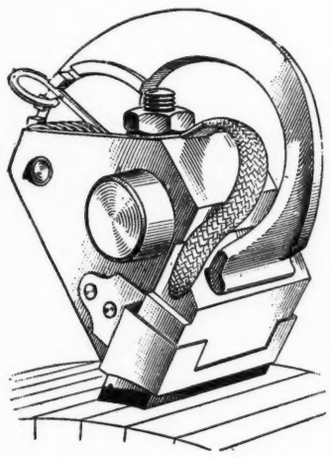


Fig. 3—Reaction-type brush-holder

Survey made by

BRUSH DATA
Prepared Especially for

Date..... Sheet No.....

Prepared by

NOTE: To order brushes it is only necessary to specify the Item No. and quantity of brushes desired. No other data is required

Item No.	Machine No.	Machine Unit	Location	Manufacturer	Serial No.	Type	Rating	Volts	Amps.	R. P. M.	Comm. Slotted	Brushes Per Set	List Price Per C	Stock Record
1	5	Rotary	Sub. Sta. A	Whse.	4507522		500KW	600	833	1200	yes	36		
2	11	Rotary #5	Sub. Sta. A	G.E.	477095	HC-20	1000KW	600	1666	360	yes 6 comp rings	160 36		
3	8	Coal Elev.	Coal Stg.	Al. Chaln.	68321		35HP	115	225	900	yes	8		
4	9	Air Compr.	Mach. Shop	Elec. Dyn.	6852		55HP	220	205	600	flush	4		
5	12	M.G. Set	(Gen. (Motor	Whse. Whse.	4323112 4323126		1000KW 1420HP	600 11000		900 900	yes 2 st rings	54 4		

Fig. 4—Data sheet on which to record information, required when ordering brushes

then in stock, a standard list of 100 styles was drawn up, which is giving satisfactory operation on the entire electrical equipment operated by this company. Similar analysis in other instances has shown that one may expect to reduce the number of brush styles to a figure from one-third to one-tenth of the original number.

A data sheet such as illustrated in Fig. 4 is valuable for convenience in carrying the record of standardized brushes. Copies of this list can be provided for the purchasing department, the storekeeper, the operating engineer and any others interested. The operating engineer thus has at hand a complete list of his electrical equipment and item numbers for the brushes required. The storekeeper can see at a glance all machines for which a given type of brush is required and be made up to the purchaser's specifications after the order is received.

Lack of standardization makes it impossible for the brush manufacturer to carry finished brushes in stock with the exception of a few isolated styles for which there is a steady demand. As standardization of brushes becomes more general in the electrical industry, it will be possible for the brush manufacturer to stock an increasing number of active styles. Delays in delivery will be reduced correspondingly. Every industrial plant that puts into effect the plan of standardization suggested in this series of articles will simplify its own brush problems and will also render substantial aid to the efforts now being made for general standardization in the brush industry.

Santa Fe's

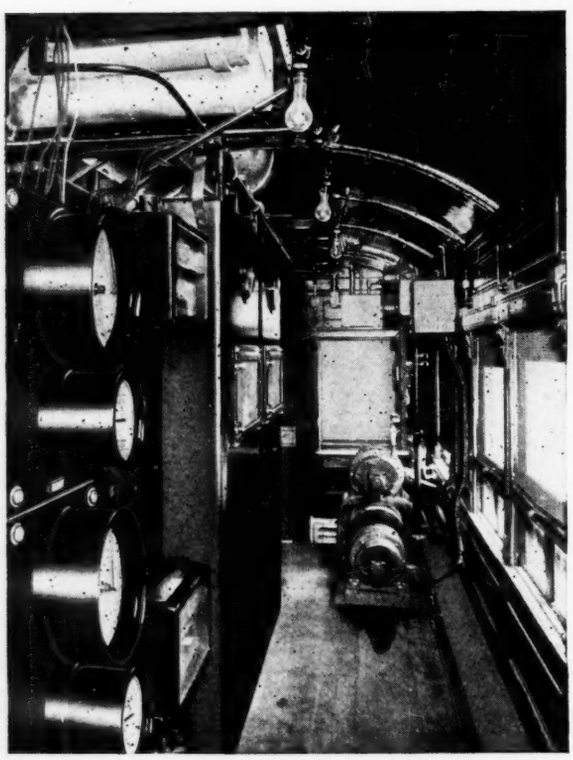
Portable Laboratory

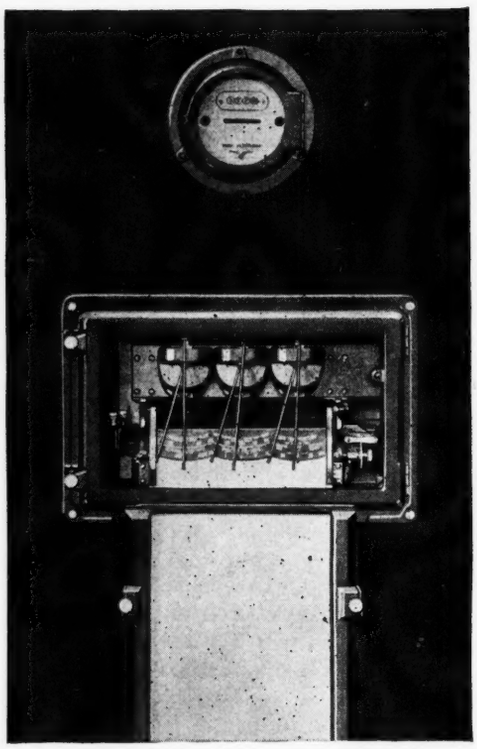
Checks 80 Power Stations

A converted business car provides the means of transporting test equipment and furnishes an office and living quarters for the testing crew. Use of instruments that could not be shipped by the old box method has resulted in economy, more accurate records, and in the dissemination of desirable operating practices

MORE than a year ago the Atchison, Topeka & Santa Fe Railroad converted an old business car into a portable laboratory and equipped it for testing the 80 power plants, exclusive of small pumping and heating stations, operated by this railroad. So far as possible each recording and integrating instrument was fixed in place on panels in the car, and the portable instruments were located definitely, so as to keep them all in first-class condition and entail the minimum loss of time in placing them in operation or in secure condition for movement.

View in instrument room showing circular-chart recording and integrating units





Republic boiler-test panel, showing the multiple-type recorder using a strip chart and, above, the integrator for obtaining cumulative readings

The 80 plants, ranging in nominal rating from 1,500 to 90,000 lb. of steam per hour, occupy a vital place in the maintenance of actual operation of the railroad. In 1928 they burned the equivalent of 466,000 tons of coal, costing $1,323,000, and had an annual operation charge of $2,039,000.

Thirty of the plants use coal, forty burn oil and ten are supplied with natural gas. The larger plants furnish both alternating and direct current, compressed air, water and steam. Other plants have no generating equipment, and the smaller stations supply only steam and water.

In the past a power-plant inspector had checked up operations to standardize methods and equipment and to correct wasteful practices. The cost per pound of steam, the distribution of the steam generated, the relative cost of fuels as affected by the different handling charges and accessories required, called for more careful investigation than could be obtained from the ordinary plant records or inspections. Central power companies often made attractive offers to furnish power to plants already generating their own, and to consider these offers intelligently required a test of the local plant to determine the cost of generation. Where facilities were used jointly with other roads, tests prorated the distribution of costs of steam and electrical power and established the actual cost of steam, air and electricity.

These various demands resulted in random tests of plants. Box shipments of equipment were made, with the accompanying losses, breakage and delays. As the power needs increased, enlarged plants with more extensive equipment resulted, and a study of the trend of industrial development showed the advantages of such new instruments as recording pyrometers, steam,

air and water flow meters, draft gages, CO_2 recorders, electrical characteristics of the generators and their electrical load. Such equipment was not readily portable, and the idea of a power-plant test car was conceived and worked out in a conference of the mechanical department. A description of its contents has been made available by E. E. Chapman, engineer of tests, in a paper before the Western Railway Club, at Chicago.

The car is self-contained, excepting provision for meals. The arrangement of the observation end of the car was well suited for an office. A sofa and a berth provide satisfactory sleeping accommodations for two men, In addition to serving as an office, where correspondence, references, etc., can be kept conveniently and where test results can be reckoned, this room is used as a lounging and reading space for the crew.

In the instrument room, occupying the largest portion of the car, are the racks for the instruments, a motor-generator set, Baker heater, lockers, a work bench and cabinets built to meet the requirements of the special apparatus. A locker on the front platform takes care of equipment not housed in the instrument room. Further space for equipment and fittings was provided by suspending containers beneath the car.

As steam heat is inaccessible at times, heating coils are provided to produce steam and for the Baker heater. Water is supplied by gravity from overhead tanks. A small oil-burning water heater is used. The car-lighting generator and batteries were removed as impracticable, suitable connectors being located at each end of the car for plugging into the regular station or power-house lighting circuit or into an adjacent car. Oil lamps or flashlights are used when electrical current is not available.

Instruments and equipment were selected to meet the requirements of the average power plant, and the equipment already available at the larger plants is used in conjunction with the facilities of the car.

Four recording units were selected for boiler testing, each fitted to record simultaneously on a strip chart, steam flow, CO_2 and flue-gas and feed-water temperatures. The flow meters were supplied with integrators for obtaining cumulative readings. Four circular chart-recording draft gages and similar pressure gages are used in conjunction with the boiler-test panels. Water meters, oil meters and miscellaneous indicating thermometers complete the apparatus that has been provided for boiler-room tests.

Four circular chart flow-meter units that record and integrate flow and record pressure indicate the distribution of steam, air or water. Recording kilowatt meters, voltmeters, ammeters, a power-factor meter and a frequency meter are used to obtain electrical power records.

A gas calorimeter of the continuous-flow type and a gas density balance, required for the power plants using natural gas as fuel, are carried in a special cabinet, with suitable connections in the stateroom where more constant temperatures are to be had. Samples of coal and fuel oil are forwarded to the laboratory for analysis.

A three-unit motor-generator set, consisting of a 1½-kw. single-phase 120-volt, 60-cycle generator, a 220-volt direct-current motor and a 25-cycle alternating-current motor supply 120-volt, 60-cycle alternating current for the operation of flow meters.

The boiler-test panels are electrically actuated and are intended to be left in the car at all times. Ordinarily, the distribution flow-meter units are kept on the car to minimize the work of meter installation, but a distant location with accompanying pressure record occasionally makes it more desirable to move the recorder out of the car. The electrical connections for the boiler-test panels and flow meter units are carried from the instrument to an outside terminal board, readily accessible from the front platform of the car. This terminal board has the connections to the motor-generator set and extra terminals for additional equipment.

It is usually impracticable to keep the draft and pressure recorders on the car since they require pipe connections. The electrical recording instruments, similarly, do not lend themselves easily to locations distant from the switchboard or power circuits, on account of the amount of heavy copper wire that would be required.

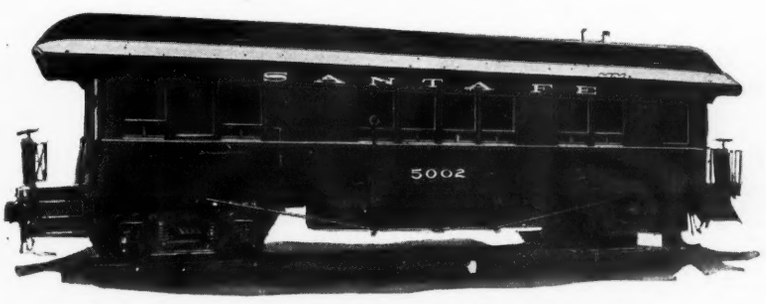
In a year of operation eleven plants were tested with the car. A retest of this group of plants can be made more quickly in the future, as the test-instrument connections were permanently installed.

Two men usually accompany the test car, although in some cases it has been expedient to send one man ahead with the car to begin the installation of equipment, the second man following a day or two before the tests are started and staying until the work is finished and equipment removed. The work of installing the apparatus is done with the help of the local shop forces. Local shop apprentices usually are available to assist with the actual test work. They help to set up the instruments and tabulate the test data.

As now conducted, the regular power-plant tests take into consideration the main elements of the plant. Unless specifically desired the steam requirements of each auxiliary pump and steam line are not separately determined. Ordinarily, the steam consumption and operation data of the main power-house machinery are desired and the steam flow to roundhouse, machine shop, car shop and sandhouse and that used for fuel-oil heating and for pumping are metered separately. The air flow usually is obtained for the major air lines going to the roundhouse, locomotive shops, car shops and freight-car yards.

The charts obtained provide for future reference a complete record of the plant operation, including all the fluctuations over the whole period considered. This could not possibly be done by the use of the more portable indicating instruments. The amount of equipment provided permits all the major items of steam and air consumption to be measured at one time instead of metering one facility and then another while assuming that every day is alike. With these data available the management has had placed in its hands accurate power-plant costs and data that will aid in better control.

Santa Fe power-plant testing car



The Head Fireman Is Responsible For Operation of the Boilers

By WALTER N. POLAKOV
Consulting Engineer, New York City

THE FUNCTIONS of the fireman, his duties, etc., have become a blind tradition. Like every tradition it has, in the course of time changed beyond recognition. Old practice and habits, which were once reasonable, are absurd with new equipment and change of fuel. New practice which is essential under changed conditions often is not properly explained and written up for reference. Moreover, certain changes in routine which may have been ordered long ago under stress of an accident, or for temporary expediency, were never revoked after the need for them had passed and gradually became a time-honored but wrong tradition. In the following is briefly outlined the scope of the head fireman's duties. These must be supplemented by detailed instructions written by the chief operating engineer and revised at least annually.

The duties of head fireman consist in generating steam of required pressure, in quantities needed, consuming 1 lb. of coal to generate——lb. of equivalent steam.

To accomplish this task he should:

A—At the beginning of his shift:

1. Examine safety valve by lifting.
2. Examine water gage, try all cocks.
3. Inspect blowdown valve by touch.
4. Inspect feed valves, line and pump.
5. Examine boiler setting for cracks, etc.
6. Look over tubes for bags, blisters, holes, etc.
7. Try dampers and set drafts to load.
8. Take readings on steam and water.
9. Report to watch engineer.
10. Relieve outgoing firemen from duty.

B—During his watch:

1. Regulate draft, attend to fires and feed water so that steam flow line (red) and air inlet line (blue) are together; steam pressure between 225 and 230 lb. and water level steady at second cock.[1]
2. Inspect frequently feed-water pumps.
3. Watch out for smoke and avoid it by regulating draft and firing lightly, not over five shovelfuls per door at a time.
4. Consult indications of CO_2 recorder and keep CO_2 about 12 per cent by adjusting damper and condition of fuel bed.
5. Observe flue-gas temperature frequently (green line). Blow off soot once during the watch.
6. Blow down every boiler on night shift by opening valve slowly and gradually until fully opened then close it up slowly; do not keep it open longer than is necessary to reverse turning the valve handle.
7. When blue line is above red line (and this is not due to fast feeding of water) take scraper and level up fires covering holes; close door and observe pens. Coal evenly fresh charge and adjust damper after.
8. When blue line is below red line (and this is not due to closed feed-valve), shape the fires, get out clinkers and level up the fuel bed. Close doors and observe lines. If still below, open up a damper until lines are together.
9. Never fire before shaking or leveling.
10. When safety valves begin to rattle, feed water fast if there is room; if it does not help, open up firedoors, but close them at once when safety valves quiet.
11. Before cleaning fires, put twenty shovelfuls to a furnace. Wait until smoke is gone and green coal white hot. Scrape it to back side. Dump half grates at a time. Have damper nearly open. Spread charge evenly. Fire lightly. Quench ashes. Proceed with the other half when steam pressure is back.

C—At the end of the watch:

1. The outgoing fireman is *not* relieved from his duties until the incoming fireman has finished his inspections.
2. Report to incoming fireman all orders and irregularities noted.
3. Read and record together with the incoming fireman the steam meters and feed-water meter.

NOTE: These readings shall be taken always when steam pressure is 230 lb. and water at the second cock.

Responsibility: Firemen are directly responsible to the chief operating engineer and receive orders from nobody else except from the watch engineer if so authorized by the chief operating engineer.

Authority: The fireman has authority to operate all valves, pumps, auxiliary equipment, etc., in accordance with instructions properly issued and approved by the chief operating engineer.

But no instrument, recording or indicating, shall be touched or tampered with under any circumstances except if pressure line connecting same breaks. All matters pertaining to instruments must be at once reported to the chief operating engineer.

Upkeep Work: The fireman is responsible, under supervision of the chief operating engineer, for the proper, safe and clean keeping up of boiler house, including all the equipment, machinery, etc.

He cleans and repairs furnaces, washes out boilers, with proper help, sees that the premises are clean and sanitary and requests from the chief operating engineer such assistance as may be needed for keeping up everything in A-1 condition.

Co-operation: The fireman should co-operate with the watch engineer by calling his attention to every irregularity, sluggishness or any other defect in the operation of equipment, machinery, tools and instruments.

He must co-operate with any men sent in for boiler repairs and co-operates with them in safeguarding them from accidents, especially if working on pressure lines and in other dangerous places.

He sees that all valves are properly tagged: for example, "Open," "Do not touch," "Men working inside."

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[1]In a particular case, where Bailey meters are installed.

Diesel Engineers Meet at Penn State

FOUR-DAY SESSION OF OIL AND GAS POWER DIVISION, A.S.M.E., DRAWS 300

THE second national meeting of the oil and gas power division of the A.S.M.E. was held at Pennsylvania State College, State College, Pa., June 24 to 27. From the expressions of the 300 engineers who attended, the meeting was a distinct success, both in the bringing together of engineers to exchange views and in the presentation of noteworthy papers on the oil engine.

After registration was completed, on June 24, the first session was opened with an address by Dr. R. D. Hetzel, president of Pennsylvania State College, followed by a paper on "High-Speed Oil Engine Design," by Otto Nonenbruch, of I. P. Morris & De La Vergne, Inc.

In opening the subject, the speaker pointed out that the term "high speed" is employed to designate engine speeds from 600 r.p.m. upward, but it should be limited to speeds above 1,000 r.p.m.

He expressed the feeling that high speed is being overdone in some respects and predicted that the slow-speed oil engine has and will always have its place where continuous heavy loads are to be carried. In his study of the relative weights and pressures of engines of various speeds, he presented a table showing dimensions of both gas and oil engines. The crankshafts of gasoline engines are not as heavy as those of Diesel engines, and this applies likewise to cylinder walls, crankcases and other parts. Mean effective pressures are a little higher than those of the Diesel having the same margin of safety; but the m.e.p. varies widely, depending upon the design and service requisities.

The stroke-bore ratio of the Diesel engines examined varies from 1.33 to 1.57. These are more than the usual gasoline values, due to the higher compression ratio of the Diesel and the necessity for a flat combustion chamber of reasonable depth. Shaft diameters of high-speed Diesels average 60 per cent of the cylinder bore. Main bearings are universally suspended, and the connecting rod length to piston stroke is 2 to 1. Cast-iron pistons predominate, for aluminum is not necessary at the present speeds.

The speaker pointed out that raising the existing speeds can be obtained only through improved combustion and fuel-injection devices. In striving for this, builders employ various basic principles ranging from air-injection to precombustion chambers. This paper will be published in full in a later issue of *power*.

In discussing the paper, E. Nibbs, chief engineer, Electric Boat Company, stated that he believed a formula was needed to permit classification of engines. He suggested that the heat released by combustion per square inch of piston crown area is a proper criterion by which to judge engines. Another formula would embrace the m.e.p., the number of cylinders, the stroke, the bore and the r.p.m. The product of those factors divided by the weight gives 40,000 for some high-speed oil engines, 38,000 for high-speed gas engines and 400,000 for aviation gasoline engines. It is his opinion that the two-stroke cycle will be the one used by the high-speed engine of the future.

P. B. Jackson, Aluminum Company of America, agreed that the heat release was the determining factor in high-speed design. In his opinion, aluminum pistons are and always will be necessary in such engines, for the heat conductivity is much higher than is that of cast iron.

J. L. Goldthwaite, Allison Engineering Company, pointed out that at exceedingly high speeds the connecting rod is in tension and the maximum loads occur

Some of the engineers at the Penn State meeting

at the bottom end of the stroke, where no gas pressure existed to oppose the inertia focus, quite contrary to conditions in a slow-speed unit.

The second paper at the Monday session, on "High-Speed Oil-Engine Pumps and Injection Valves," was presented by J. L. Goldthwaite, Allison Engineering Company.

The speaker stated that when a cloud of fine oil particles is sprayed into the hot air of the combustion chamber the smallest drops are heated most rapidly, ignite when they reach a certain temperature, and burn. The larger drops are heated more slowly, ignite later, and, providing they find the necessary air, burn longer. If mixing is not uniform, the smallest drops will have the first chance at the air immediately surrounding them, and the combustion of the larger drops will be further delayed for lack of air. Later on, during the expansion stroke, these large drops may find their air and burn completely or they may decompose and make soot; in the first case they produce more heat than power, in the second case, more smoke than either heat or power. Large drops slow up the combustion and make the process more difficult to control.

But the design of the fuel system is closely bound up with the design of the combustion chamber. In an engine designed without great turbulence the injection valve must both atomize and distribute the fuel. If turbulence is used to mix the charge, this function of the valve becomes less important; finally, in the precombustion engine, only moderate atomization is needed, for the violent ejection of the partly burned charge from the antechamber effects both mixing and rapid combustion. However, as the injection system is improved, the problem of the combustion chamber becomes simpler. With an ideal injector, little or no turbulence would be necessary; the antechamber would probably disappear, and one could determine the shape of the indicator diagram by the profile of a cam.

Providing a Fine Spray

Our problem, then, is to produce a sufficiently fine spray and project it where wanted—accurately metered, of course, and correctly timed. The difficulty of the problem is proved by the bewildering number of pump systems and valves to be seen in current practice, and by the low m.e.p. in most of the successful engines. It is much easier to get 90 lb. m.e.p. in a 5½-in. cylinder than 110 lb. in a 5-in. one.

If oil is forced through a small round orifice, a solid stream is formed at low pressure; but if the pressure increases, the jet becomes unsteady and finally breaks into a conical spray. With any given nozzle, the size and uniformity of the drops are functions of the jet velocity, that is, of the injection pressure. Nozzles may vary in efficiency, but there is only one way to get fine atomization, and that is by using very high pressure. And since excellence of combustion is a function of atomization, other factors remaining the same, we should expect the efficiency of the engine to increase with the injection pressure. Heidelberg demonstrated this to be true, at least up to about 4,000 lb. pressure in the oil line.

The speaker discussed the various types of nozzles, pointing out that with precombustion chambers the single round orifice nozzle is satisfactory. The centrifugal nozzle, while not as good as the multiple-hole orifice, has the advantage that it eliminates the drilling of microscopic spray holes. More attractive types, so he claimed, are the conical and the flat seated valve, the conical being the better of the two.

The spray formation with the conical valve deserves special attention. The valve projects a thin sheet, in the shape of a conical surface of which the valve is the apex. As the diameter increases, the thickness of the sheet necessarily diminishes, until a point is reached at which the sheet can no longer maintain continuity. At this point it literally bursts into spray. For example, if a valve ½ in. in diameter opens .001 in., the thickness of the sheet at 3 in. diameter will be .00017 in., about the same as the diameter of the drops produced by air injection with a blast pressure of 1,100 lb.

THE Diesel engineer has turned from the old rule-of-thumb method of designing engines and has embarked upon a study of the physcial phenomena of oil-spray formation. Outstanding among the workers in this field are the engineers at Langley Field, who have taken moving pictures of sprays formed by various type nozzles.

At any given opening and pressure, the sheet will break into spray at a definite distance from the nozzle. Hence, we can project the sheet into a definite part of the combustion chamber and there convert it into spray. Both surfaces of the sheet, presenting a large area to the air and moving at the terrific velocity of 9,000 ft. per second at 5,000 lb. oil pressure, will set up a powerful air turbulence moving toward the spray. If the valve is heavily spring loaded, its opening will vary with different fuel pressures, and the spray cloud will be formed at varying distances from the valve so that during the rise and fall of oil pressure in the injection cycle some part of the spray will be produced in every part of the combustion chamber.

Any of the valves can be built either as open-type or closed-type nozzles. The open type is always open to the cylinder, and the oil flow is controlled entirely by the pump. A light check valve may be used to prevent the cylinder air pressure from penetrating into the fuel lines. The closed type has a spring-loaded valve or its equivalent, which is opened either by a cam or by the pressure of the fuel.

The open nozzle is much simpler, as it has no moving parts. It has another decided advantage: Any air that finds its way into the pump will pass out freely through the nozzle, whereas in a closed system under high pressure a tiny bubble will lock the entire system. But it has a grave objection; since oil pressure cannot be built up or relieved instantly, the start and the finish of every injection must necessarily take place at low pressure, and those portions of the spray will be coarse. The same thing happens at low speeds, when the pump plunger is moving too slow to build up a high pressure against the constant outlet area. Of course, at low speeds the atomization need not be so fine; it may even be desirable to delay ignition by such means.

The closed nozzle, on the other hand, can be set by spring tension, to a definite opening pressure. It remains closed until this pressure is attained, and closes promptly when the pressure falls. Consequently, all the

spray is injected at high pressure, regardless of speed or pump characteristics. Against this must be set the possibility of leakage, especially if a high pressure is maintained in the injection pipe between injection periods. A leak may have serious results in the engine. If a closed valve is not nearly perfect, it will be a total failure.

Opening the discussion, O. D. Barrett stated that too much stress was being placed upon the subject of lapped pump plungers. He found that the leakage due to wear is of more importance and must be taken care of. A secondary pump delivering oil at 4,000 lb. to the injection pump was recommended. In one engine it was necessary to change the plunger with a change of oil, as kerosene leaked badly when used in a pump designed for fuel oil.

C. B. Alden, Excello Tool & Manufacturing Company, said he knew of no case when there had been a change in the rate of plunger leakage except when the oil contained grit. Engine builders should specify fuel oil on the basis of viscosity, ignoring gravity. This is especially necessary with high-speed engines, where atomization must be accomplished quickly, which, in turn, depends upon the surface tension of the fuel.

D. J. Juhasz was in favor of the common-rail, or continuous pressure, fuel system. He claimed that it eliminates variation due to pipe friction. He has found that the pressure starting at 6,000 lb. drops to 3,000 at the nozzle and then rises to 4,000 lb. due to a secondary pressure wave.

At the Monday evening session the engineers were privileged to listen to a paper by W. F. Joachim, Westinghouse Elec. & Manufacturing Company, on "Combustion in High Speed Oil Engines."

The author, starting from observed spray actions in a combustion chamber, discussed the basic reasons for the shape and density of the fuel sprays. It was his contention that the small time interval prevented the vaporization of the oil particle and that combustion changed the liquid particle directly into carbon dioxide or water vapor. Most of the paper was an attempt to apply pure reasoning or logic to the subject, using observed actions as the ground work of the argument. The speaker ventured the theory that each oil particle took on the form of a comet, with the tail made up of a cloud of oil molecules widely separated. The character of the cloud made combustion easy, but this was offset by its position behind the oil particles' front. The paper was from a physicist's point of view, and the speaker felt that high speed could be accomplished only through an extensive study of an oil particle's characteristics.

THE principal subject of discussion and conversation at Penn State was the high-speed Diesel. Due probably to the popular attention given to aviation, engineers display deep interest in the design problems of the high-speed Diesel. At least ten firms are experimenting with this type, although a commercial engine is still absent.

In the discussion on this paper, B. Frauenfelder, consulting engineer, stated that he had found when testing a $2\frac{7}{8}$-in. bore solid-injection Diesel of German make that to obtain best results at 1,000 r.p.m. the compression and the explosion pressure had to be high.

Another speaker pointed out that while it was quite proper and necessary to do research in design details, in his opinion, the skill of the operator was of equal importance, the best designs suffering in the hands of an ignorant operator. In the discussion, the opinion was expressed that it took five years to prove an engine design. Prior to that time life and operating characteristics were but matters of opinion.

Julius Kuttner was inclined to discount the value of Mr. Joachim's paper, which view was strongly contraverted by Dean Sackett, who stressed the fact that abstract reasoning and research were the basis of all advancement in science.

A more commercial point of view was held by Chester H. Gibbons, Marion Steam Shovel Company, in his paper on "Application of High-Speed Oil Engines." The author stated that the economic factors that have dictated the Diesel have been enumerated and expanded upon so frequently as to merit little more than a mention in passing. In comparison with the gasoline-fueled engine, the wide range of fuels and their generally lower cost per unit; greater thermal efficiency with attendant smaller radiators; more perfect combustion with less carbon deposition and less valve distortion; ease of starting; advantageous speed-torque characteristics; lower fire risk; simpler construction, particularly in respect to both mechanical and electrical phases, have all had adequate handling, as has also the reduced radio interference in aircraft service.

There is a distinct and insistent demand for a high-speed Diesel that with equal reliability will take the place of the gasoline engine and will occupy little or no more space and weigh little. The long period of education in the use and operation of gasoline engines will be capitalized—it will not take much education or effort to train one acquainted with the gas engine's peculiarities to understand and properly handle the high-speed Diesel. In reality, it is simpler in construction, and once the principle is grasped, the rest follows readily.

There have been no commercial applications to trucks in this country, although in Germany they have been in use for a number of years, and more than 100 are in regular service. One builder of high-speed Diesels in this country has installed one of his engines in an ordinary four-ton truck. This was accomplished without extension of hood or change in radiator. In fact, in order to maintain the proper temperature in winter it was necessary to use more radiator cover than was used on the gasoline trucks.

A prominent manufacturer of tractors in the Middle West has just put into service a tractor equipped with a high-speed Diesel engine, but as yet no data are available in regard to operating costs. No particular problem was involved in this application beyond the necessity of strengthening the chassis and gear trains, together with clutches, etc. This necessity arises from the sharply increased torque at low speeds as compared to the gasoline engine formerly used. This increase for a given speed amounts to as much as 30 per cent.

An application to generating sets is the so-called "Western Union" generating set, so named because it was developed to meet the need of Western Union buildings for a self-contained generating unit for use in various localities where by city ordinance the use of a gasoline engine in the basement of a building is pro-

hibited. These sets are usually employed as standby units. They have the advantages of small floor space and small head room. For example, a 100-kw. set needs a floor space of 42-in.x165-in. and a head room of less than 90-in. over the radiator.

In New York City at the present time because of the high costs of purchased power, there is an active interest on the part of owners of buildings in the possibilities of high-speed Diesel generating sets, because of the opportunities of heat reclamation from the jacket water and from the exhaust gases, and because of relatively low initial costs, low head room, and small floor space. While so far as the author knows there have been no installations, it is a field is opening and one in which the manufacturer of the high-speed Diesel is particularly interested, since it is usually the case that there is no excess of space available for installation, in the basements of existing buildings.

Engines for Cotton Gins

In the cotton-growing states there have been numerous applications of the high-speed Diesel to cotton ginning. These are usually belted installations, and an unsuspected collateral advantage is secured. Because of its relatively light weight and small dimensions, the engine during the season when no ginning is being done is transferred to other work, such as the operation of dredges or of irrigation pumps, and like services.

A recent development of much promise and interest is the application of high-speed Diesels to oil-well drilling. These units are usually 4- or 6-cylinder, 60- and 90-hp., respectively, 6x6½-in., and operate up to 800 r.p.m. They are skid mounted to effect ready portability and are belted to a countershaft carrying a clutch. This, in turn, is belted to the bandwheel, which carries the crank or lever that imparts to the walking beam its oscillating motion. The strong hold which steam has had on this industrial application has been due, in part, to the automatic speed variation achieved by steam throughout the cycle of one turn of the bandwheel. This consists of a speeding up following the fall of the tools in the hole and a reduction in speed during their rise. In addition, the driller had a complete control of average engine speed through the engine throttle. Both of these features are retained in this installation, as there is a manual control by which the engine speed can be varied from 250 to 800 r.p.m. There is a periodic control that varies the speed of the bandwheel each revolution thereof above and below the average speed, which is under the control of the driller.

Demand in the Excavating Field

In the excavating-machinery field there have been several commercial applications, and several others are about to be announced. This development has been an unusually interesting one. While it is true that the major evolution took place during the time when gasoline engines were used exclusively, there was an ever-present desire for the opportunity of securing the fuel economy and simplicity of the Diesel. In general, however, this could not be done on the smaller sizes because of space limitations on the one hand or because of a general redesign on the other. With the appearance of the high-speed Diesel requiring about the same space as a gasoline engine there was a prompt response, and every manufacturer of excavating machinery has investigated, or is investigating, the engine. Several designs are in use at present.

"Modern Refinements in Diesel Power Plants" was the subject covered by Edgar J. Kales at the Tuesday morning sessions. In this paper the operator pointed out that engine builders should display a greater interest in engine accessories. Pointing out that many units are installed when noise is objectionable, he suggested that silencers be used. As air contains much dirt and grit he felt that an air filter should be installed with each engine. Lubricating oil reclaimers likewise are valuable adjuncts of a plant and should not be eliminated by reason of the slight extra cost.

Other accessories were taken up for discussion by the author. This paper will be printed in full in a future number of *Power*.

R. L. Howes, Fairbanks, Morse & Company, opened the discussion by stating that the auxiliaries needed should be stressed more by engine builders and by accessory manufacturers. In addition salesmen should be instructed to give more attention to the needs of the particular plant. The speaker's company now insists that each engine order be accompanied by full information on prevailing wind direction and average atmospheric temperature; type of cooling tower to be used, kind of fuel and other items needed to ascertain if the plant equipment is sufficient.

Percy Maxine stated that his company was supplying silencers both for intake and exhaust piping. He felt that engine builders should get away from the old cast-iron muffler, which is never efficient.

W. A. McGill, De Laval Separator Company, spoke on the new types of oil centrifuges. In his opinion, oil-filtering apparatus paid for itself in one or two years in direct saving in oil.

W. K. Gregory, Reed Air Filter Company, then showed a number of slides illustrating various designs of air filters. It has been found, he stated, that the air filter should have a capacity of 7 cu.ft. per min. per horsepower rating of the engine. In large installations he recommended the automatic, or self-cleaning, filter, which, however, is too costly for small engines.

Diesel Courses in Colleges

The second paper he presented at this session was on "Diesel Education," by Roswell H. Ward.

The speaker had made a study of the courses offered by the various technical schools on Diesel engines. He found that only four offered any distinct course and felt that more schools should take up this type of prime mover.

In the discussion, Prof. R. C. H. Heck, Rutgers College, stated that one should not expect detailed study of engines in any school. The aim of a technical school was to give the student a firm understanding of basic principals. In a general discussion that ensued all the speakers supported Professor Hieck.

The sub-committee on oil-engine power cases, of the Oil and Gas Power Division, A.S.M.E., gave a condensed tabluation of the data compiled from the information received from 27 plants, representing a total of 38,315 hp. The total output of these plants during the year 1927-28 was 75,395,250 kw.-hr. Individual units ranged from 75 to 2250 hp. and are located in eleven states, giving a fairly representative unit cost with Diesel power.

The cost of fuel oil ranged from 2.44 to 6.74 cents per gal.; the fuel used to produce a kilowatt-hour ranged from 0.62 to 1.288 lb. The rated—horsepower hours per gallon of lubricating oil ranged from 400 to 16,650, making the costs vary from 0.16 to 1.99 mills per de-

livered kilowatt hour. Attendance ranged from 0.84 to 92.5 mills per kw.hr. The median values for the 27 plants in mills per kw.-hr. were:

Fuel oil	4.2
Lubricating oil	0.43
Attendance	2.82
Supplies	0.63
Repairs	0.66
Total, mills	8.74

H. C. Thuerk, Associated Gas and Electric Company, stated that as a member of the National Electric Light Association's Committee on Power Costs he was much interested in the report. However, the values given apparently were not median values but weighted averages. By using the proper values, the average costs amounted to over 1 cent per kw.-hr. output of the plants listed.

L. H. Morrison, associate editor of *Power,* was of the opinion that such a study was of little value. A purchaser of an oil engine was not interested in costs in a poorly operated plant; what he wanted was the cost in a well run plant, exactly as a man going into any business wanted to know what could be reasonably expected if the business was conducted as a prudent man would run it.

Others supported this contention, and the committee agreed to study the matter with a view of obtaining costs in representative plants.

Repairing Large Engines

The paper on "Maintenance and Repair of Marine Diesels," by Louis R. Ford, Union Dry Docks, was, in the opinion of many, the outstanding paper of the meeting. While applying to marine engines, the data given can be applied to all engines of the heavy-duty type. It will therefore be published in a future number of *Power.*

Briefly the author claimed that while marine steam engines are well standardized, the Diesel is not so favorably situated. The cost of repairs on it is high; for even engines of the same make and design, built in the same year, differ remarkably. It is impossible to predict what repairs cost until the engine has been taken apart.

Mr. Ford took up each major part of the engine in turn, and related experiences he had had with engines of various makes. Too little attention is given to the flexibility of the ship's structure, and as a result of improper cargo loading, in some instances, the engine frame may become badly distorted.

In conclusion, he stated that the Diesel plant apparently requires less repair than the steam plant but the repairs that are required cost more. An important difference in the two types of machinery is that a broken or worn-out part of a steam engine or boiler can be replaced at the majority of ports in the world, utilizing the local facilities at those ports, whereas a replacement part for the Diesel engine must be sent from builder or obtained from some other distant, especially equipped plant. Very few Diesel-engine builders have devoted serious effort toward rendering quick, efficient and cheap repair service to users of their engines.

Due to the lack of time, general discussion of this paper could not be held. It was the consensus of opinion, however, that the author had presented a valuable contribution to Diesel engineering.

L. M. Goldsmith, Atlantic Refining Company, stated that piston rings wear rapidly in some engines on account of too narrow a width. If a so-called sealer ring be used this ring should have at least $\frac{3}{8}$ in. of metal on each side of the ring it encloses.

H. E. Brelsford, Worthington Pump and Machinery Corporation, favored the chromium plating of pump plungers, but had found that the plating peeled off if not properly applied. The thickness of the pealing averages 0.003 in. He explained that the reason Diesel repairs cost more than steam-plant repairs is that the latter consist of applying steel plates, rivets, tubes and other parts carried in stock, while the Diesel parts are all of individual design. To eliminate head fracture due to scale, he recommended that the water supply be not throttled but be provided with a recirculation line so that on light loads part of the water passes back to the engine without being cooled. As scale settles when the water velocity is low, this procedure should eliminate the deposits. Some of the rod failures mentioned in the paper were due to the insistence of the purchaser that alloy steel be used. When mild steel rods were substituted, breakage disappeared.

Wednesday afternoon a golf tournament occupied the attention of a greater part of the engineers. Others visited the exhibit of accessories.

In the evening Dean Sackett, of Pennsylvania State College, presided as toastmaster at the banquet. H. H. Suplee was expected to give his personal recollections of Dr. Diesel but unfortunately, he was unable to be present.

A short talk on the early history of the Diesel engine was given by L. H. Morrison. Practically the same material appeared in the June 25 number of *Power.*

The last session, that of Thursday morning, was taken up by two papers. The first reporting progress made by the special research committee on Diesel fuel specifications was presented by Wiley H. Butler, Standard Oil Company of New Jersey. The committee has prepared tentative specifications both for high- and low-speed engines. The latter is the one that will receive the earliest attention, and, as the speaker stated, the oil refiners and engine builders have shown a spirit of co-operation.

Mysteries of Fuel Oil

It must be conceded that certain oils that meet the specifications do not, apparently, act properly in an engine. To ascertain what can be expected from the standardized fuel, the committee will send certain users a few barrels of the specification oil so that the user can report back the results. It was emphasized that the specifications offered are not final, but after sufficient data has been collected to permit the interested parties to arrive at a sane conclusion the larger oil refiners will offer this fuel at an attractive price.

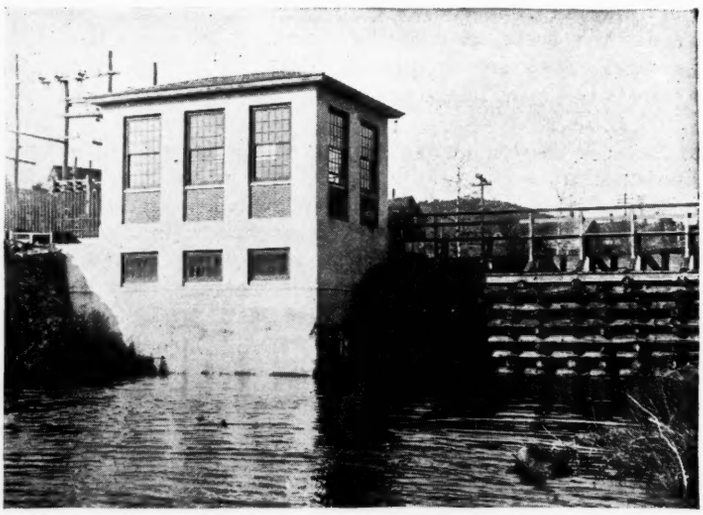
It was the often-expressed belief that the committee has been able to show remarkable results in but a year's existence. All who spoke were enthusiastic over the report, and it was decided that the paper, with the discussion, would be re-edited and distributed to the technical press.

The final paper of the conference was on "Standardization of Oil Engine Rating," by H. E. Brelsford, Worthington Pump and Machinery Corporation. It was the speaker's belief that it was possible arrive at an equitable rating method by following the system used in rating electric motors. Motors are rated on the temperature rise, so the speaker advocated that a similar plan be followed with engines. The rating actually would be based on the mean effective pressure, which, in turn, controls the final cylinder and piston temperatures.

How Interchange of Power *has built* Community Prosperity

By Francis A. Westbrook

While industries have at times left New England through lack of cheap power, there are instances where successful measures have been taken to reduce the cost of power in that part of the country. These measures have not always received the attention they deserve. They have been various, exceedingly ingenious and are suggestive of what might be done in other communities. They have placed some of the oldest sections of the country on a competitive basis with any other part, as far as power is concerned, and the result has been that many a plant which otherwise would have moved South or West has been saved for New England. The best way to show what has been done is to quote from a recent interview which the author had with the manager of one of the New Hampshire divisions of the Twin State Gas & Electric Company. His remarks follow:



Note no water is going over the dam in this small water-power station

WE FEEL that our first duty to our community and to ourselves is to do everything possible to contribute to the prosperity of its industries. It is good business in every way. It means not only reducing rates to the lowest point consistent with a reasonable profit, but to a point comparable to other sections of the country in the South and West, where they are at a minimum. It is one of the most important means of keeping industries from moving to other localities.

In other parts of the country low rates have been due largely to the development of water powers, generating stations near coal mines, the construction of long high-voltage transmission lines, or improvements of machinery. While all these have been made use of here, our conditions are different, and we have made low rates possible by other, rather unique, means. That they are really low is shown by the fact that we actually undersell some districts in the South. We accomplish this by making use of every possible source of water power and by not burning a pound more of coal here, where coal is very expensive, than we can help.

The conditions here are peculiar in that a large number of the available water-power sites were acquired many years ago by manufacturers making a variety of products before the electrical era. They still are owned by these private concerns or their successors, so that only a limited number of water powers have been open to us to develop. We have made use of these, and originally we built a steam plant besides, but this was expensive.

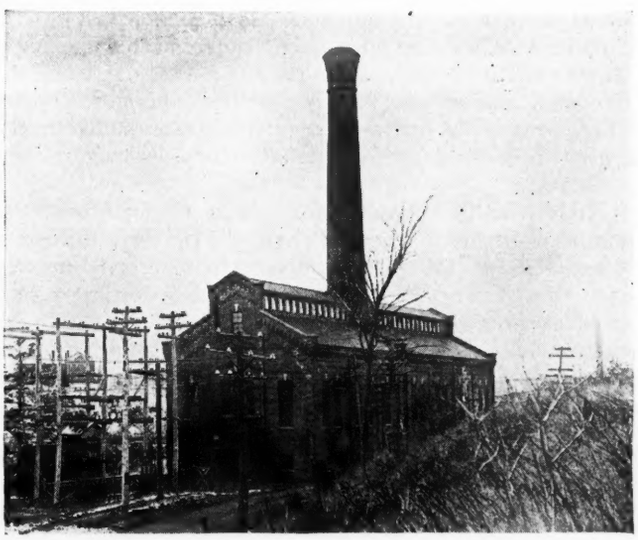
What we did was to make arrangements with the plants having their own water powers to sell us their surplus. During periods of low water they have to buy power from us, and some of them do not have enough when they are running at full capacity even during seasons of high water. But at one time or another they all allow water to run to waste over the dam. It may be at night or because they are running slack or for any one of a number of reasons. It is easy enough to avoid this waste by keeping the waterwheels running, and, as they are connected with our system anyway, it is a simple matter for them to turn their surplus into it. The result of this is that sometimes a manufacturing plant sells us more power than we sell them and that it makes a net profit.

As there is considerable diversity of manufacturing, one line may be slow and the other active, so that when one is slack its surplus power is used for a plant that is busy. In addition to this purchase of surplus water power, we have arranged to purchase steam-generated power from those plants that have auxiliary steam units. Most of them had installed steam units, some quite a while before they were connected with central station service. Thus in very dry weather or in any other emergency these can be started up and the power purchased by us. In the case of a wood-working plant in our division we have rather an unusual arrangement. This concern has a steam-electric unit and uses its waste wood for fuel, but there is more than enough of this than necessary to supply them with their power requirements. So we got them to run their generating equipment all night on the surplus waste wood, and we buy the power.

In another case a man came to us who had three undeveloped water-power sites and wanted to know what he could do with them. He was willing either to sell

them or develop them with his own resources and sell us the power. We recommended the latter and made a long term contract to buy his output. It also sometimes happens that a mill shuts down temporarily, and then we always buy all their water power. It is only on the rarest occasions that anybody will ever see water going over any dam around here. Of course, we are interconnected with all of the generating stations in the surrounding towns and, through them, throughout New England generally, so we can dispose of any surplus we have on hand. In 1927 we sold 4,005,000 kw.-hr. to other utilities, power that otherwise would have gone to waste over many dams. Often a mill shutting down on the other side of the state supplies the power for one at peak load on this side. Power secured in this way is cheap, and yet its sale even at a low price is of real advantage to the concern supplying it. Our connection with steam central stations insures power when the water is low, and the small private steam plants are a safeguard in case anything happens to the transmission lines. We have a steam plant of our own, but this is normally shut down.

Actually, we are very much of a power exchange. As anyone can see, we are supplying power with a very small amount of generating equipment, and most of it is hydro-electric. This is what enables us to charge such low rates that we can compete with almost any part of the country. It has already saved many an industry for New England, and it will bring in new ones; for the possibilities are by no means exhausted. I will never forget the first time it happened. It was over in Vermont, where a large manufacturing plant that was the mainstay of the town was going to move to the Middle West because it could get cheaper power. We made an investigation and found that at this company's private water power site more water power was being wasted than was being used. We ran a line down there, told them to install greater generating capacity, run it twenty-



Old central steam generating station now used only as a stand-by and to house the dispatcher's office

four hours a day and agreed to purchase all that they could give us. The result was that this company's net rate was lowered so much that they were much better off to stay where they were. So the manufacturer was better off, the town was saved and we were saved, because no central station company can amount to much in a down-and-out community.

In anything of this kind I think the initiative must come, at least until the practice becomes well known and well established, from the central station company. The manufacturers do not seem to think of it themselves. Somebody has to take the leadership. We seem to be in the best position, because we are in contact with all of them.

Metering Errors in Steam-Heat Industry Are Discussed

THE POSSIBILITY of lowering the metering errors in the district-steam-heating industry by extending the use of flow-type meters was discussed in a paper presented at the twentieth convention of the National District Heating Association recently held at Detroit.

An analysis of the steam production and sales of 33 companies, made by W. W. Stevenson, author of the article, brings out the fact that of the 20.9 per cent overall loss between steam produced and steam sold, 10 per cent is chargeable to metering. "The metering losses in electric utilities are practically negligible," Mr. Stevenson states, "yet we accept a loss of 10 per cent in heating utilities chargeable to metering alone, and say it is unavoidable."

There were 11,700 condensation meters in use during the six-year period that was analyzed, while the number of steam-flow meters was but 201. The condensation meter itself can be made almost perfect as a metering device, the article points out, yet the fact that steam and water losses on customers' premises are not registered leads to a serious inaccuracy. In fact, all of the building losses, at joints, air vents, etc., and all the deliberate draining, either to secure hot water, to eliminate water-logged piping, or purposely to lower the steam bill, must necessarily be charged against metering accuracy with this type of instrument.

In buildings where the piping systems are free from leaks, and a vacuum is maintained throughout the season, condensate metering may be 97 or 98 per cent perfect. But for every one so found, the report states, there probably exists two older buildings in which the heating company may consider itself fortunate if 85 per cent of the steam is measured.

"One of the most undesirable results from this," the article goes on to say, "is the effect it has upon the customer. It tends to lower his confidence in the integrity of the heating company when he sees steam bypassing his meter. He knows that the sum total of such losses must be provided for in the steam heating rates."

The advantages of this volumetric type of meter that have caused it to be retained in the face of these losses are its accuracy on extremely low rates of flow, when compared independent of condensation losses, and its low price.

Recent improvements have been made, the report states, in the shunt type of rotating flow meters that promise much in that direction. Greater accuracy at low rates of flow, or, at least, easy calibration to compensate for this error, and the presence of the "open upper limit," which does away with the limitation imposed by a chart record, are of considerable advantage.

"It is evident," the report concludes, "that a smaller over-all metering error is possible by the use of flow-type meters in the district-heating industry. The problem remains as one application."

Right Out of the Plant

Three Men With a Hose Do the Work of Six

THE intake flume for condenser-cooling water of the Canon City plant of the Southern Colorado Power Company is provided with heavy wire screens to prevent débris from entering the flume. The screens extend across a width of about 50 ft. and are paralleled by a boardwalk on which men with poles and hooks walk as they pull up trash from the screens and deposit it on the boards, where it is hauled off. In times of high water as many as six men are needed to keep the screens free and the trash hauled away.

Then someone though of attaching a heavy fire hose to a pump and using the stream of water to wash the débris toward the two ends, where one man at each end lifted the material out and into trucks. The hose washed leaves and small trash away much better than it was possible to do with hand tools.

Although used only at times of spring floods and high water, the idea proved valuable just when the men were badly needed elsewhere. L. E. WILSON.

Denver, Colo.

Controlling Steam Pressure Automatically in a Small Plant

THE steam-pressure line shown on the chart, Fig. 1, is typical of what was obtained regularly after we installed the regulator shown in Fig. 2. With the exception of the regulator unit, the making or assembly of the

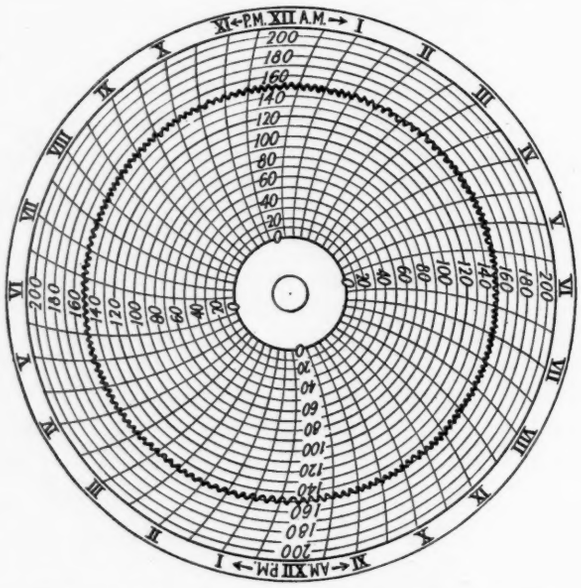


Fig. 1—With the regulator the steam pressure fluctuates 1½ lb. each way from normal

necessary parts and the work of installing was done by the operating staff. Before the regulator was installed the changing of the dampers and the raising and lowering of the feed latches on the stokers to meet the varying steam demands proved taxing to the men, particularly on shifts where only one man was in charge.

We first of all purchased a hydraulic regulator and attached the plunger, by means of pulleys and weights, to

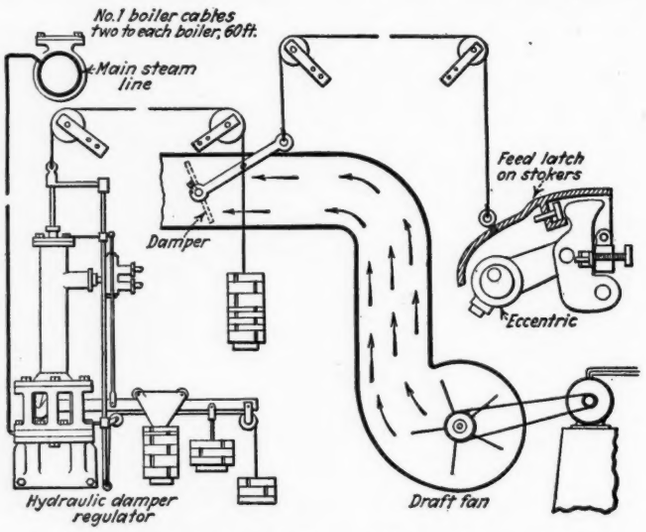


Fig. 2—Arrangement of regulator and connections to stoker-feed latch and fan

a butterfly damper placed in the main air duct, so that when the steam came up to the desired point the forced draft would be shut off automatically. This single control had the objectionable feature that the coal kept on feeding after the air was shut off, so, by means of additional counterweights, flexible cable and steel pulleys with turn buckles for fine adjustment we connected the regulator to the feed latch of the stokers. This overcame the difficulty, and we obtained a complete automatic control of the fires. The hydraulic regulator was mounted on the engine-room wall for convenience of observation and adjustment.

At 150 lb. the air and coal are shut off simultaneously and, as is apparent from the chart, the pressure fluctuates about 3 lb. at 150 lb. pressure (a pound and one-half each way). The device has now been operating a year and has proved reliable. The total cost was approximately $275, but the operators consider that it was well worth while, as they are saved many miles of walking, and the labor and attention required in regulating the fires are reduced to a minimum. C. A. CUTTING.

Humboldt, Sask., Canada.

Correcting Some Pump Troubles

I WAS sent out to pass on the construction work of an electrically operated pumping station and, if satisfactory, to start it up and arrange for an operating crew. The station was equipped with a 150-hp. and a 75-hp. synchronous-motor-driven centrifugal pump. Each pump was direct connected to its motor by means of a magnetic clutch.

The larger unit had been assembled at the pump manufacturer's plant and was shipped ready to run. The

other unit was shipped in sections from the various manufacturing concerns and was assembled by local mechanics. The smaller pump drew water from a stream and discharged into the suction line of the main pump.

When the large motor was started, several difficulties developed. When these had been overcome, the motor was put into service and the clutch was closed. The pump started, but as the load was applied a bad vibration was set up. Investigation showed the pump and motor to be badly out of line. This trouble was cured and the unit was again operated. After the small pump went into service our attention was drawn to a curious pulsation on the water meters. This was at first diagnosed as due to a fire engine operating on the water line. A check showed that assumption to be incorrect. Starting up again, we found the pulsations still existing. Next we discovered that the clutch was heating badly, owing to slippage. The clutch was adjusted, but still it slipped. The only remedy was to set the clutch members closer together, which proved a rather difficult job. The clutch was also adjusted on the large pump. Both pumps then ran nicely for about two days, when, for no apparent reason, the flow and discharge pressure of the large unit began to fall off, and a severe vibration was sometimes apparent. The intake was examined to make sure that no air was being entrained with the water. Next the pump casing was removed, and a 2x4 scantling and a large tree root were found in the intake side. In the impeller were two glass telephone insulators and a collection of ballast, brickbats and broken tile. After these had been removed, the pump revived and the output became normal.

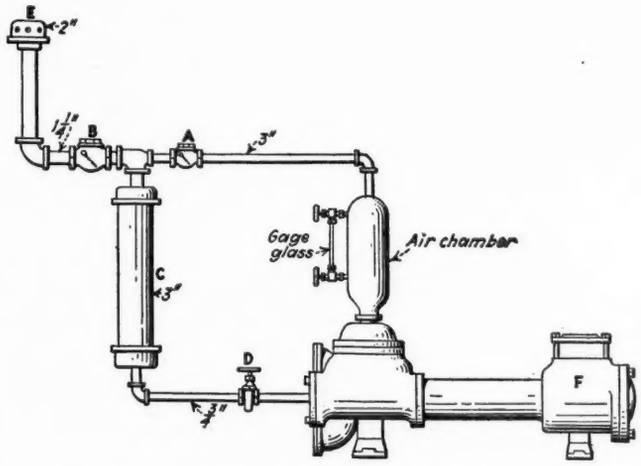
PHILIP N. EMIGH,
Chief Electrician,
Byrne Gas Coal Co.

Byrne, W. Va.

Improvised Pump for Air Chamber

CONSIDERABLE trouble was had in maintaining air in the air chamber on our feed pump, so we rigged up the air pump illustrated from odd fittings we had on hand.

A hole was drilled and tapped for ¾-in. pipe in the end plate of the feed pump on which the air chamber is located, and a pipe was connected from this point to the bottom of the chamber *C*. *A* is a ¾-in. check valve, *B* a 1¼-in. check valve, *C* a 3-in. pipe 24 in. long, and *D* a gate valve.



Water chamber connected to pump maintains air supply in air chamber

The operation of the air pump is as follows: When the valve *D* is opened, water fills the pipe *C* from the pump cylinder *F* during the discharge stroke of the pump. By partly closing *D* when *C* is full, the pump during the suction stroke will draw a part of the water from *C*, and air will flow in through *B* to take its place. During the next discharge stroke of the pump, more water is forced into *C*, driving the air out through *A* and into the air chamber. If *D* is opened too wide, all the water will be drawn out of *C* during the suction stroke and air will be drawn into the pump cylinder through *B*; but by properly regulating the opening, a column of water is kept in *C*, which acts as a piston that moves with the strokes of the pump and pumps air into the air chamber. *E* is a 2-in. pipe cap put on the end of the intake pipe to keep dirt from falling into it. Six ½-in. holes are drilled in the side of the cap for air intakes.

Since this device was put on there has been no trouble from lack of air in the air chamber and no more pounding in the pipes.

NELS HILSEN.

Duluth, Minn.

Loyalty Still Pays

SEVERAL of us "old timers" were in the smoking compartment out of Chicago the other night, and as usual the conversation turned to plants and engineers, and finally to the subject of co-operation between the office and the plant. Then someone sprang the subject "loyalty." This recalled the editorial on "Loyalty Still Pays" in the April 2 number. I sat up and began to take notice.

"You speak of loyalty on the part of the workman," said the speaker. "Well, loyalty, like friendship, to be of any value, must be mutual and work both ways. It should come down from the top as well as come up from the bottom. Oh, I know that you will say I am a pessimist and that I am 'knocking,' but let me tell you that you will find that the average workman has just about as much loyalty to the boss as the boss has to him. I have seen, and no doubt some of you have too, where the boss would not take the part of his men, would on any or all occasions 'pass the buck' to the men in the boiler room or engine room, when he was the man at fault, and if anything turned up that was a discrimination or infringement of their rights he would not take up their defense. Yet he would be the first man to complain about loyalty of the men.

"Then again, we have men that have dug down and bought instruments and other tools to prove to their boss that he was losing money. They have worked late at night and all of their spare time to bring about savings in the operation of their plant; have boosted and inspired their men with the spirit of loyalty and interest in the company and its business, and then we have seen these same men sidetracked and someone who has not taken any more than usual interest pass them by and get a promotion.

"All workmen are not dumbbells, and any man that is worth a grain of salt knows when he is doing his best and when he is doing better than the other fellows who are rubbing elbows with him. When a man of this class has put in his best of loyalty, interest and co-operation for the company and he sees some other chap, that he knows hasn't done one-tenth what he has, pass him on the road to promotion, it will put a considerable kink in the loyalty curve, downward."

THOMAS M. STREET.

Wilkes-Barre, Pa.

Welding a Leaky Handhole

THE answer given to the problem in the May 21 number concerning the welding of a leaky handhole plate recalls a repair we made.

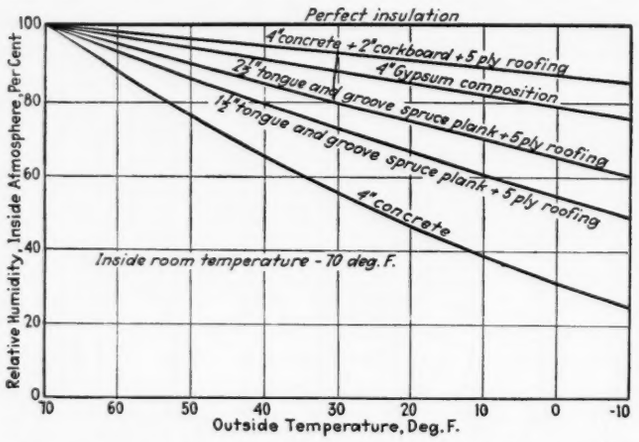
We had been having trouble on a 72-in. x 18-ft. horizontal-tubular boiler that had a 4x6-in. handhole. This opening had corroded so badly that there was a continuous leak. A ring 1 in. wide and $\frac{5}{8}$ in. thick was set along the edge of the opening and welded in place. This has been in service for five years without leaking. The handhole cover seats against the ring and remains tight.

Watertown, Mass. THOMAS A. WALSH.

Sweating of Piping and Buildings in Cold Weather

MOST modern power plants are housed in well-constructed and well-ventilated buildings of substantial walls and roofs, with sufficient insulation to avoid excessive lowering of the interior surface temperatures.

However, there are many present-day industrial plants that maintain buildings constructed of thin-section ma-



Curves show points at which condensation will appear for various atmospheric conditions

terials of considerable heat conductivity. Some are walled or roofed with corrugated sheet iron. Many of these buildings contain steam equipment with traps, bleeders, hotwells, etc., that give rise to steam vapors, which tend to raise the temperature and humidity of the atmosphere sufficiently that the dew points are relatively high. In such cases, sweating or moisture condensation appears in cold weather.

I can recall several buildings housing large turbines and steam engines where in zero weather it literally rained, water dropping on the equipment and causing a general nuisance. All cold-water piping was continually wet, resulting in corrosion and considerable maintenance.

In one building some rather interesting data were taken. This building contained the electric generating equipment. The generators were cooled with a washed-air recirculating system. In the basement were various steam pumps, traps, bleeders and a small hotwell, so that considerable water vapor was dissipated into the atmosphere of the basement. The building was constructed of 9-in. brick walls, with large window-glass area. The roof was made up of 1-in. planking covered with regular corrugated sheet iron. The building was tight, with little outside air infiltration.

The inlet ducts of the generator recirculating cooling air system in the basement were arranged so that either outside or return air from the generator room could be utilized for recirculation. This return air was taken through the basement, the generator-room air passing through open stairways into the basement and thence to the inlet duct. In extremely cold weather the outside ports were closed and practically all the air was recirculated. The water for the sprays was also recirculated from a well, so that this water was considerably warmer than fresh water would have been, giving greater moisture in the delivery air.

Such were the conditions when the readings were taken. The data, as taken by means of sling psychrometers, were as follows:

TEMPERATURES OBTAINED IN BUILDING WITH BRICK WALLS AND COMBINED PLANK AND SHEET-IRON ROOFING

Location	Bulb Temperatures Dry, Deg. F.	Bulb Temperatures Wet, Deg. F.	Moisture per 1,000 Cu.Ft. Air Lb.	Relative Humidity, Per Cent	Dew Point, Deg. F.
Generator Room:					
North end	58.5	50.0	0.59	76	51
Between generators	59.0	53.6	0.56	68	50
South end	60.0	52.7	0.51	62	47.5
On crane (south end)	64.0	56.0	0.56	58	50
Average	60.2	....	0.552	66	49.6
Cooling Air System:					
Fresh-air end (closed)	50.0	46.5	0.45	78	45
Cellar end (open)	62.5	57.5	0.67	75	54.5
Just before sprays	54.0	49.0	0.46	68	45
After sprays but before generator	52.5	51.0	0.58	91	50
Top of generator	58.0	62.5	0.61	41	53
Cellar:					
Near air duct	69.0	59.5	0.64	57	54
Near stairway	74.5	66.8	0.88	66	63
Head of stairs leading to generator room	80.5	76.25	1.32	84	74.5
Outside atmosphere	24.5	21.0	0.11	50	10

Spray-water temperature, 50.5 deg. F.

No temperatures were taken on the ceiling owing to inaccessibility. It can be noted that the conditions throughout the generator room seem uniform, with a dew point averaging about 50 deg. With zero weather outside and a poorly insulated roof, it can readily be seen that the inside ceiling temperature could easily drop below this dew point with sweating and condensation. Cold-water piping at about 40 deg. would accumulate water.

The accompanying curves show the limits of relative humidity for several types of structures, or rather the conditions at which condensation will appear for various atmospheric conditions. In this curve it is assumed that the room temperature is maintained at 70 deg.

Condensation will occur at points above the curves for each given wall or roof. If the structure is made up of a combination of materials, condensation may occur between the layers, resulting in possible deterioration of the materials. Below the curves no condensation will occur. For example, for a 4-in. concrete wall, with an outside temperature of, say, 20 deg., the relative humidity must not exceed 47 per cent for a 70-deg. inside temperature. Otherwise there is danger of sweating. The properties of various atmospheres under different conditions of humidity, dew point, etc., can be obtained from standard reference books.

From the foregoing, it is evident that the essential items governing moisture conditions in buildings are:

1. Insulation of structure; the better the insulation the less likelihood of condensation.

2. Maintenance of minimum atmospheric humidity and lowest comfortable room temperature.

3. Good ventilation and air changes in room, with cold-air and cold-water sprays, if necessary, in generator circulating systems.

L. C. BREYER.

Pittsburgh, Pa.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Close-Coupled Belt-Driven and Direct-Connected Generating Units

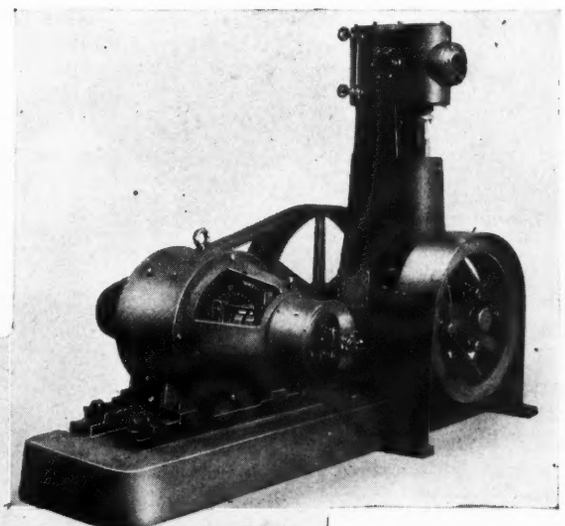
THE illustrations show the new Texrope-driven and direct-connected alternating-current generating sets recently added to the line of units put out by Enberg's Electric & Mechanical Works, St. Joseph, Mich.

Texrope-driven units are now available in capacities from 3 to 31½ kva. The unit shown consists of a standard four-pole stationary-field type alternator with direct-connected exciter, connected to the engine by Texrope belts and mounted on a common cast-iron sub-base with a standard vertical enclosed engine. The alternator and exciter both are fitted with ball bearings and all coils are vacuum impregnated. The generator is mounted on slide rails, providing a ready means of adjusting the tension of the belts.

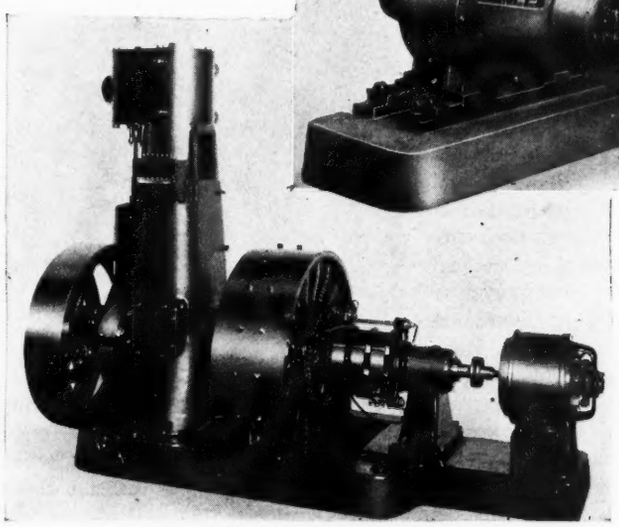
The advantage of this type of unit over a regular belted installation is apparent. It takes much less space than would be necessary with a standard belt and slightly more than a direct-connected unit, and being mounted on a common base it can be tested at the factory and shipped as a unit.

The direct-connected set is similar to the standard line of machines put out by the company except that the generator has a stationary instead of revolving field, and a direct-connected exciter. The complete range of the direct-connected sets is now from 12½ to 125 kva.

The engines used with the sets are the standard line made by the company. They are especially designed for high pressures and superheated steam, and are fully inclosed with counterbalanced crankshaft, piston valve and automatic or throttling type governor.



Right—Texrope belt-driven unit mounted on common base-plate



Left — Direct-connected unit with stationary-field generator and exciter

Vertical turbine for auxiliary drive

Vertical Steam-Turbine Unit

THE Murray Iron Works Company, Burlington, Iowa, has recently added to its line of turbines two frames of vertical machines as illustrated, for driving deepwell pumps, vertical fans and pulverizers or other auxiliaries. These turbines are equipped with constant-speed and emergency governors operating independent valves, and may also be equipped with constant-pressure governors.

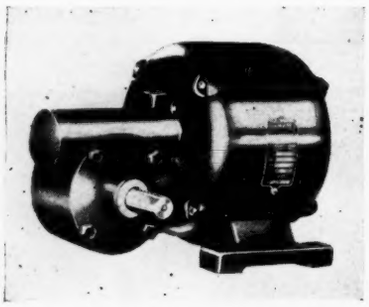
The blading and nozzles are of the standard, non-corrosive, non-erosive Murray type. The packing is carbon, steam-sealed. All disks are forgings with two rows of blading on each wheel. The turbines are equipped with extra nozzles for overloads or decreased steam pressure arranged for manual or automatic operation as required.

Small Speed-Reducing Power Unit

A SMALL speed-reducing power unit, with motor and reduction gear close-coupled and mounted on a single base, is illustrated.

The unit is available with motors ranging in capacities up to ¼ hp. and with speed reductions ranging from

20 to 1 up to 50 to 1. Standard gear ratios may be obtained as follows: 20, 26, 32, 34, 38, 40, 44 and 50. With a motor speed of 1,750 r.p.m. countershaft speeds are obtainable from 87.5

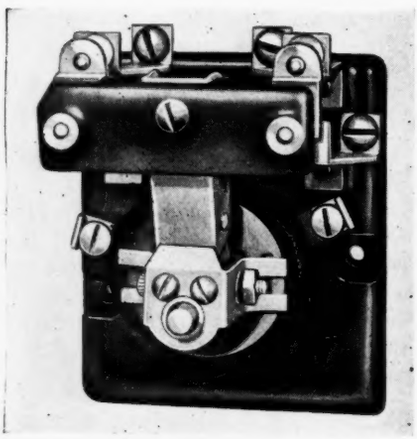


Speed reducing power unit for right-angle drive

down to 35 r.p.m. The worm is of hardened steel and the gear is of Bakelite. Motors are furnished in either d.c., split-phase, or repulsion-induction a.c. types. The unit is put out by The Janette Manufacturing Company, 556 West Monroe St., Chicago, Ill.

Small Alternating-Current Contactor

FOR apparatus requiring an automatic control switch of small capacity, the No. 701 contactor has been put out by the Allen-Bradley Company, 286 Greenfield Ave., Milwaukee, Wis. The contactor is provided with aluminum contacts and the entire assembly is mounted on a



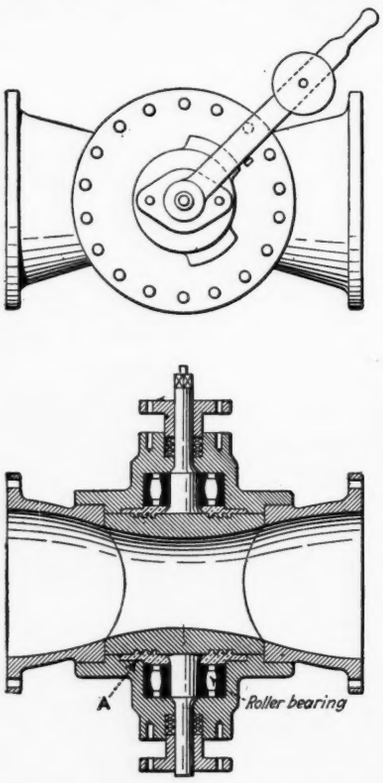
Small capacity contactor

molded Bakelite base. All switch parts are cadmium plated to prevent corrosion. This switch can be provided for operation on 6, 12, 24, 110, or 220 volts and for any frequency from 25 to 60 cycles. Current ratings range from 15 to 30 amperes.

New Stream-Line Quick-Closing Cock

THE illustration shows a quick-closing cock developed essentially as a dependable safety emergency stop for high-pressure steam turbines where tight seating is not required. Advantage of this condition is taken to reduce the unbalanced forces by employing a loosely fitting cock, the opening through which constitutes the throat of the Venturi-tube-shaped passage through the valve.

The valve body is made of cast steel and is machined to receive the



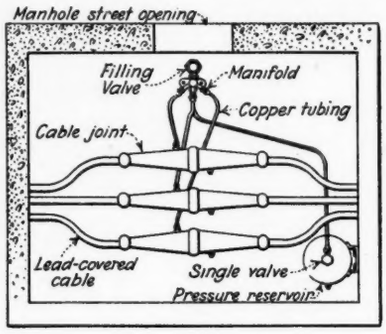
Assembly and sectional views of cock

cylindrical plug, which rotates on two roller bearings recessed inside of the body. To avoid axial displacement, the plug trunnions are turned down where they leave the bearings and are extended outside of the valve body, through stuffing boxes. In some cases labyrinth rings, as shown at *A*, are included, to prevent dirt getting into the roller bearings. A shallow groove in each trunnion carries off the leakage steam.

The operation of the valve is simple. It will close by gravity when the weighted lever is released from its 45-deg. position by the opening of a latch. The latch may be actuated mechanically, electrically or hydraulically. The valve is manufactured by Franz Leiffert & Company, Berlin, Germany.

Pressure-Type Oil Reservoir for High-Tension Cable

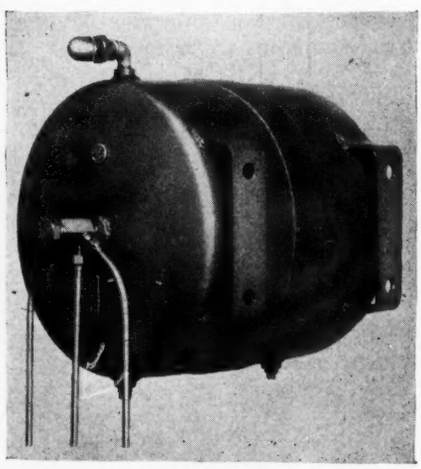
A NEW oil-pressure reservoir which takes care of expansion and contraction of oil resulting from cyclic change in load and seasonal



Reservoir is placed either above or below the cable

temperature, the principal causes of voids in insulated cables, has been announced by the General Electric Company, Schenectady, N. Y.

The tank, of galvanized metal, contains gas-filled, metallic cells with flexible corrugated walls. When the cable is heated, the oil in it expands and is forced out into the reservoir. The oil contracts when the cable cools, and the oil in the reservoir is forced out into the cable by the pressure built up during the heating cycle. The reservoir thus keeps the oil in the system under pressure at all times. The design of the reservoir is such that the oil is never in contact with the air



Reservoir complete with valve and three-way manifold

and cannot absorb gas or moisture. The preferred location for the reservoir is above the cable, but where space is limited it is placed below with a manifold above.

New Line of Draft Gages With Oil-Leveling Plunger

THE adoption of an all-metal one-piece oil chamber fitted with a hollow oil filling and leveling displacement plunger is a feature of the new line of draft gages recently intro-

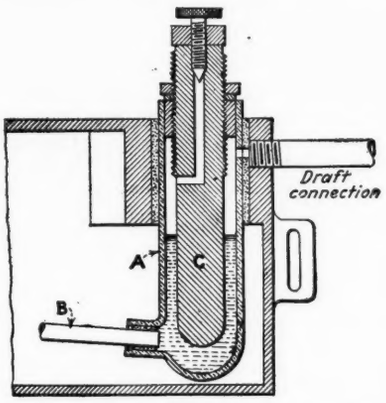


Fig. 1—One-piece oil chamber with oil-leveling plunger

duced by the Defender Automatic Regulator Company 308 South 8th St., St. Louis, Mo. Referring to fig. 1: *A* is the one-piece metal oil chamber to which the inclined glass tube *B* is connected. The plunger *C* is made adjustable vertically in the chamber to provide a ready and practical means of leveling the oil in the tube or bringing it to zero on the scale. The upper part of the plunger is drilled to provide an opening for replenishing the oil supply.

The combination draft and pressure gage for forced draft chain-grate stokers shown in Fig. 2 is made

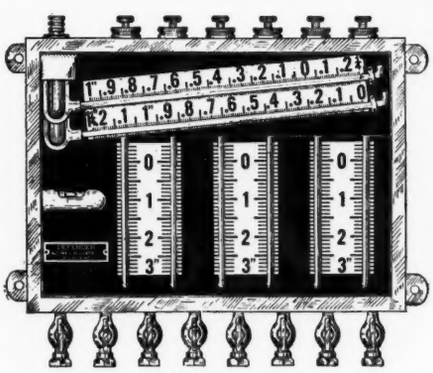


Fig. 2—Combination draft and pressure gage for forced draft chain-grate stokers

with from four to eight pressure gages in the one case and is furnished with 3 or 7 in. vertical scales. The two inclined tubes at the top are for indicating the draft over the fire and in the last pass of the boiler. Any combination of scales can be furnished for these tubes. The vertical tubes are connected with the pressure in the wind boxes or zones below the grate.

All tubes have bottom connections through $\frac{1}{8}$ in. petcocks. The dimensions of the gage illustrated are 12 in. high and 14 in. wide. The case and cover are made of polished aluminum.

Explosion-Tested Type Controller for Small Motors

A NEW controller of the drum type which provides across-the-line starting for small motors, has been added to the line of explosion-tested type motors and controllers, put out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It is provided with fuses mounted inside of the case and

Explosion-tested controller

interlocked with a screw-type cover to meet the requirements of the U. S. Bureau of Mines for explosion-tested equipment.

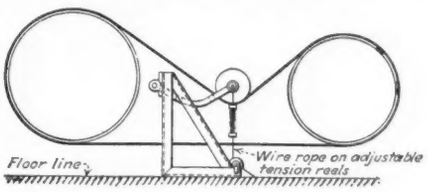
Accessibility is one of the features of this small controller, which is provided for by mounting the entire controller on the bottom base. The base is threaded to screw into a cylindrical case. Removing this case uncovers the entire controller.

The controller is designed as a small compact unit for application on conveyors, loaders, hoists, small pumps and similar types of apparatus where explosion-tested equipment is required.

Short-Center Slack-Belt Drives

THE illustrations show two types of slack-belt drives, designated "belt-slacker," introduced recently by Harry M. Perry, 638 North Main St., Los Angeles, Calif.

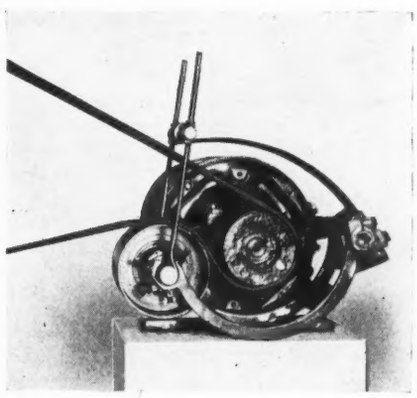
Fig. 1 shows a drive designed for use between two large pulleys and especially for use with gas engines or similar drives where a jerking



Adjustable-tension device for use where belt has a jerking action

action is given to the belt. The tension pulley, which is light in weight and mounted on anti-friction bearings, is supported from an angle frame, and the tension is produced by two springs one at each end of the pulley attached by wire cable to a tension reel on the base of the angle stand.

The device shown in Fig. 2 was developed especially for use with a drive where the slack belt must necessarily be on the bottom. In this case the pulley is supported by two curved arms mounted on a hinge bar that is attached to the motor stator. A cantilever spring mounted on the same hinge bar produces the tension on the belt the free end of the spring being connected with the pulley shaft



Cantilever spring type device for belt drives

through two rods as shown. Adjustment of the tension is made by two nuts on the crossbar at the free end of the cantilever spring.

A similar device is also available for use where the slack belt is on top.

FROM AMONG THE READERS'

Conducted
By
L. H. Morrison

BURNING SCREENINGS.—*One of our* NSATISFACTORY FUEL OIL—*In our cannot keep up steam in an industrial locomotive is that the screenings melt and stop up the fire bead. Another engineer claims that it is the quality of the screenings that is the cause of the difficulty and recommends the use of 1½-in. screenings. Is it advisable to go to the larger size screenings?* W. R. S.

Probably the basic cause of the trouble is the quality of the screenings. Usually, screenings carry more foreign matter than does run of mine or the prepared sizes, consequently the sulphur and other substances melt. A better grade of coal should reduce the trouble.

SIZE OF WIRE FOR MOTORS.—*What size wire is required to transmit 350 hp. at 0.75 power factor, 1,500 ft.? The circuit is 60-cycle three-phase 2,200 volts, and the conductors are spaced as is usual on standard cross-arms. The 350 hp. is divided among a number of motors, which are grouped near the end of the 1,500 ft. line.* S. A. B.

When working out the size of conductors to supply a group of motors, a load factor is generally assumed, but as the characteristics of the load are not given, a 100 per cent load factor will be used, which is the highest. The current per conductor in a balanced three-phase circuit may be determined by the formula $\frac{I = \text{Hp.} \times 746}{1.732 \times \text{P.F.}}$. In the problem the assumed horsepower load is 350; the volts E, 2,200; and the power factor is 0.75. Then the current

$$I = \frac{350 \times 746}{1.732 \times 2{,}200 \times 0.75} = 91.4$$

amperes. If the resistance volts drop in the line is taken at 5 per cent, this will give a drop of $2{,}200 \times 0.05 = 110$ volts. For one conductor the volts drop will be $110 \div 1.732 = 63.5$.

The size of the conductors in circular mils is found by the formula, circ.mils $= \frac{11 \times I \times L}{E_d}$, where I equals the current in amperes (91.4); L, the length of one conductor in feet (1,500); and E_d, the volts drop in one conductor (63.5), from which circ.mils

$$= \frac{11 \times 91.4 \times 1{,}500}{63.5} = 23{,}750.$$

The nearest size standard wire to this is a No. 6, which has a cross-sectional area of 26,250 circ.mils and a resistance of 0.394 ohm per 1,000 ft., or $0.394 \times 1.5 = 0.59$ for 1,500 ft. The resistance volts drop in this conductor is equal to $0.59 \times 91.4 = 54$ volts.

This drop, 54 volts, is only that which is due to resistance. The volts drop due to inductance of the circuit should also be considered, but before doing this it will be best to check up on the carrying capacity of the wire and see if it is large enough.

The table of copper wire capacities of the National Board of Fire Underwriters gives 70 amperes as the capacity of weatherproof insulated No. 6 wire. Therefore the size must be increased to one that will carry 91.4 amperes, which, if weatherproof wire is used, is a No. 4. This size of wire has a resistance of 0.2525 ohm per 1,000 ft., or $0.2525 \times 1.5 = 0.379$ ohm for 1,500 ft. The volts drop in this conductor will be $91.4 \times 0.379 = 35$ volts.

With the conductors spaced 18 in. apart the reactance volts drop per ampere in 1,000 ft. of No. 4 conductor on a 60-cycle circuit is 0.125. Then 91.4 amperes in 1,500 ft. of conductor will cause a drop of $1.5 \times 91.4 \times 0.125 = 17$ volts. The resultant voltage drop from resistance and inductance is E_r $\sqrt{35^2 - 17^2} = 39$ volts per conductor. The volts drop between any two conductors equals the volts drop in one conductor times 1.732, or $39 \times 1.732 = 67.5$ volts. This is a voltage drop in the line of $\frac{67.6 \times 100}{2{,}200} = 3$ per cent, when 91.4 amperes are being transmitted.

Note this is the smallest wire that can be used on account of the conductor's carrying capacity. The short distance and the comparatively high voltage of the circuit has caused this condition. The value of the reactance volts drop may be obtained from a table in any electrical engineer's handbook.

AIR REQUIRED FOR BURNING COAL—*How much air must be supplied to burn a pound of coal?* H. L. B.

The air required for the combustion of a pound of coal is given approximately by the formula.

Weight of air in pounds

$$= 12C + 35\left(H - \frac{O}{8}\right)$$

in which C, H and O represent the parts of a pound of carbon, hydrogen and oxygen, respectively, in a pound of the coal. For perfect combustion most fuels combine with about 12 lb. of air per pound of the fuel. But in burning the fuel, to insure that each atom of carbon will meet with an abundance of oxygen for complete combustion, more air must be admitted to the furnace than is necessary for the combination. The weaker the draft the more excess air will be required for this purpose. With natural draft it is usual to provide for a supply of about 100 per cent excess air, and with forced draft about 50 per cent. As a pound of air at 62 deg. F. has a volume of 13.14 cu.ft., with natural draft the provision for air supply should be about $12 \times 2 \times 13.14 = 315$ cu.ft., and to be practicable for obtaining the necessary boiler capacity the different sizes should be stoked in alternate layers, with changes of size and thickness of the layers so timed as to obtain complete combustion.

BOILER IS OIL COATED—*We opened one of our boilers and found that the tubes and shell were thickly coated with oil. I want to clean it, but the owners think this unnecessary. What is advisable?* A. F. B.

The boiler should not be put back into service until the oil has been removed, or you will have trouble with leaky joints and blistering. To clean the boiler, fill it with water to about the usual running level. Then add one pound of caustic soda and one pound of soda ash per 1,000 pounds of water. Dissolve these chemicals before pouring into the boiler. Close up the boiler and start a light fire sufficiently to raise about 5 lb. steam pressure. Boil for two days and then empty the boiler and wash with a hose.

UNSATISFACTORY FUEL OIL—*In our 500-hp. Diesel plant we have just purchased a tank of oil that was supposed to meet the engine builder's specifications. The engines will not handle this oil satisfactorily, and the exhaust pipe not only smokes badly but also throws out red hot carbon particles. What is wrong?* M. M.

The oil may meet the builder's specification and still be unsatisfactory. There are many characteristics of a fuel oil that are as yet unknown. Just what causes the imperfect combustion cannot be determined easily, but most oil men claim the trouble is due to the aromatic compounds. Why not have the oil company test the oil?

PROPER GRATE SURFACE—*We have an 84-in.x20-ft. h.r.t. boiler, having 2,234 sq.ft. of heating surface. The grates are now 7x7 ft. Is this correct for No. 1 buckwheat coal if the boiler operates at 100 per cent rating?* J. S.

With the smaller sizes of anthracite a ratio of heating surface to grate surface of 30 is customary. When 100 per cent rating is carried you will need $2{,}234 \div 30 = 74.5$ sq.ft. of grate surface. The grates should be approximately 7x10 ft.

PROBLEMS

ANSWERS

from Our Readers

THE QUESTION

UNDER what conditions might the installation of both air preheaters and economizers be justified in a plant using stage bleeding from the main units for feed water heating?

P. A. W.

IN some cases, especially where boilers are operating at high ratings, the boiler exit-gas temperature is so high that if all the heat that could be economically recovered were applied to the combustion air its temperature would become so high as to endanger stoker parts, furnace walls or even the high-temperature section of the air heater itself. In such cases even with boiler feed water above 300 deg. F. an economizer, which might be either steaming or non-steaming, would be required to keep the air temperature down within safe limits.

A system of heat-transfer equipment might be econonomically justified by the consideration of the following major items:

1. Annual coal saving.
2. Fixed charges on cost of transfer surface.
3. Fixed charges on plant capacity used for forcing through the apparatus the particular combinations of air, gas and water that are involved.

In addition to these, the following items, some of which in particular cases may become of major importance, should be considered:

4. Cost of energy to drive fans.
5. Building space available or cost of providing necessary space.
6. Probable maintenance cost of system.
7. Simplicity of operation of system.

The key to the proper relationship between items 1 and 2 is the heat absorption per hour per dollar of investment, or the heat transfer rate per square foot of surface divided by the cost of that surface. The heat-transfer rate is determined by two factors:

(a) The heat transfer coefficient (B.t.u. per sq.ft. per hr. per deg. temperature difference), which with a gas flow of say 7,000 lb. per sq.ft. free area, is approximately 4.0 for an air heater and 7.4 for an economizer.

(b) The mean temperature difference. Due to the fact that there is less air than gas going through an air heater, the air temperature rises faster than the gas temperature drops. The net result for a given final exit temperature is that as the boiler exit temperature is increased, the mean temperature difference between gas an air decreases. With an economizer, however, a rise in the boiler-exit temperature increases the mean temperature difference.

Thus while the usual price per sq.ft. for economizers is $2.25 against $0.90 for air heaters, there is a definite boiler-exit temperature above which more heat is absorbed per dollar by an economizer than an air heater. Economizer surface con be economically user to reduce the gas temperature to this critical temperature and then air heaters should be used to reduce the gas temperature the rest of the way to the final exit temperature.

Item 3 is usually slightly in favor of an economizer section because the fan power required for the gas side of an air heater or economizer doing a given amount of work is about the same, whereas the forced-draft fan power for an air heater greatly exceeds the pump power required by the economizer.

TOWNSEND TINKER,
Buffalo Gen. Elec. Company.
Buffalo, N. Y.

PROVIDED that sufficient draft is available to overcome the resistance to gas flow offered by the installation of an economizer and air preheater, the installation of these fuel savers may be justified under certain conditions. The cost of fuel is an important factor to be considered. If a low-cost fuel supply is constantly available, the complication of the installation by the addition of economizers, and air preheaters may not be justified.

In modern high-pressure boiler plants operating at pressures above 300 lb., the heat loss in the stack gases will be excessive unless an economizer or air preheater or both are installed between the boiler and the stack.

If the temperature of the feed-water leaving the high-pressure bleeder heater is less than 200 deg. F., an economizer would be preferable to an air preheater, especially if the boiler is fired by a chain-grate stoker, because the economizer could extract sufficient heat from the flue gases to lower the temperature to about 300 deg. F. and because chain-grate stokers are not adaptable to high air temperatures.

However, if the difference in temperature between the saturated steam in the boiler drum, and the feed-water leaving high-pressure bleeder heater is approximately 100 deg. F., it would not be advisable to install an economizer, and if a preheater large enough to lower the temperature of the flue gases to 300 deg. F. were installed, the resulting air temperature would be too high for chain-grate stokers, although suitable for pulverized-fuel and underfeed stokers.

In this case it would be advisable to reduce the bleeding of steam for feed-water heating, thus making the installation of an economizer desirable and at the same time obtain preheated-air temperatures not too high for chain-grate stokers.

The temperatures obtained in a typical installation using bleeder heaters, air preheaters and economizers and having 600-lb. boilers fired by chain grate stokers, are:

Flue gas entering economizer, 750; flue gas leaving economizer, 475; feed-water entering economizer, 300; feed-water leaving economizer, 375; flue gas entering preheater, 475; flue gas leaving preheater, 300; air entering preheater, 80; air leaving preheater, 225.

In several new pulverized-fuel installations a boiler only a few headers high is used. The installation generally contains an economizer about twice the size of the boiler, and a large air preheater. The temperatures obtained in such installations:

Flue gas entering economizer, 1,050; flue gas leaving economizer, 650; feed water entering economizer, 300; feed water leaving economizer, 475; flue gas entering preheater, 650; flue gas leaving preheater, 275; air entering preheater, 80; air leaving preheater, 450.

PETER G. DAHL.
Elmwood Park, Ill.

A Question For Our Readers

FOR non-condensing operation, with 200 lb. gage, 100 deg. F. superheat at the throttle, should a 500-kw. unit be a turbine or a reciprocating engine?

C. R.

Suitable answers from readers will be paid for and published in the Aug. 6 issue.

Heat Insulation Practice

In the Modern Steam-Generating Plant

By L. B. McMillan

Consulting Engineer,
Johns-Manville Corporation

This abstract of a paper presented before the Rochester, N. Y., meeting of the A.S.M.E., May 13-16, shows the greater value of the high-head heat conserved by insulation and gives curves for computing savings, as well as a convenient chart for finding economic thickness.

AN OUTSTANDING feature of recent progress in heat-insulation has been the increasing realization of the fact that, large as they are, fuel economies are by no means the sum total of the beneficial effects secured by the minimizing of heat losses from heat-using equipment. In industry in general, greater attention is being given to the effect of insulation in increasing production through the maintenance of heat potential, in improving quality of product through the maintenance of greater uniformity of temperature, and in increasing the productivity of labor through the maintenance of improved working conditions in the vicinity of heated equipment.

Nor are these indirect effects lacking in the steam power plant. Results there may not be classifiable under the aforementioned three headings, but the insulation of pulverized-coal bunkers and piping to prevent caking of the coal due to condensation, and the insulation of turbine-room roofs, cold-air ducts and condenser-water piping to prevent the troublesome drip due to condensation of moisture from the air are typical examples of cases where there are other considerations that completely overshadow those of heat saving.

The power station furnishes also one of the most convincing examples of the value of the maintenance of heat potential. The heat conserved by insulation is the most valuable portion of the heat. It is the cream, so to speak; the high-potential heat that costs most to produce and that does the most effective work.

Power engineers do not need to be told that a given number of B.t.u. at high potential will produce more power than the same number at lower potential, but the attempt to evaluate the heat in terms of its potential is worth while, and seems not to have received the attention it deserves.

With steam the value of the last increment of heat at the top of a particular temperature range is between 50 per cent and 100 per cent greater than average value for that range (the temperature range is that of the complete cycle from condenser temperature up to the given temperature).

The relative value of the last increment as compared with the average value

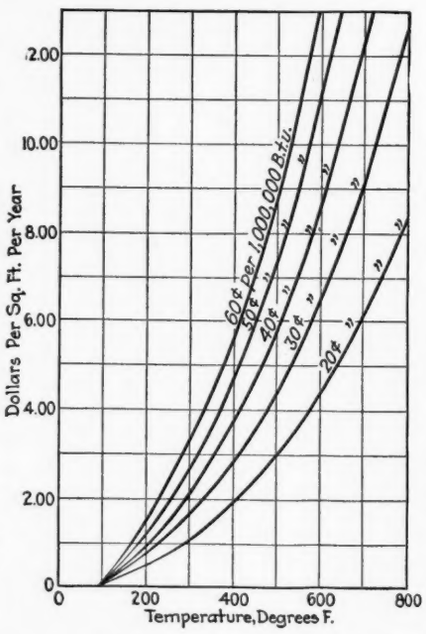


Fig. 1—Annual cost of heat losses from bare surfaces t different values of heat per million B.t.u.

of heat decreases as the pressure is increased. This does not mean that the actual value of that increment is any less. It is the same, but since the average value of all of the heat is increased at the higher pressures, the ratio of value of the high-potential increment to the average is, of course, decreased.

It is commonly felt, if there are only a few degrees drop from the superheater to the turbine, that the situation

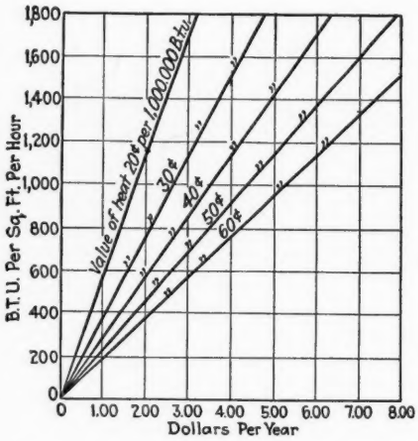


Fig. 2—Conversion chart—B.t.u. per hour to dollars per Year.

is satisfactory, and little thought is given to the dollar value of these few degrees when applied to literally billions of pounds of steam handled per year. When the dollar value is considered it usually is in terms of the fuel cost of the average and not of the high-potential heat. Yet it is this more valuable high-potential heat that figures in "radiation" losses—heat that would be available without further fuel cost, equipment cost, or operating cost.

The suggestion is sometimes offered that heat losses from equipment in power stations are not actually lost because they go to heat the building, to supply preheated air to the boiler furnaces, etc. But heat is not required to heat the building all of the time, and, still more important than that, such heat as is needed for that purpose can be obtained from bled steam having approximately only one-fourth the value of the high-potential heat yet just as good for heating purposes. Likewise the cream of the heat from the superheated-steam lines is a somewhat expensive source of heat for preheating combustion air.

In spite of the fact that it does not tell the whole story, a striking picture of the cost of heat losses from bare surfaces is obtainable by reference to Fig. 1. In this chart the equivalent losses in dollars per square foot per year of 8,760 hours are shown for various values of heat per 1,000,000 B.t.u. This chart serves to show more nearly the true

situation than would be shown by simply figuring the fuel equivalent of the heat loss, because the curve for value of heat may be chosen so as to represent the true value and not simply the fuel cost. In selecting the curve to be used in connection with superheated steam for power generation, account should be taken of the higher value of high-potential heat.

In the case of superheated-steam piping the extent of surfaces left bare is usually quite small, but, because of the higher temperatures and the greater value of the heat, the losses from such small areas may be much greater than would at first glance appear to be likely or possible. For example, the loss from one square foot of bare surface at 700 deg. F., and at a value of heat of 30 cents per 1,000,000 B.t.u., is $9.30 per year. If the steam pressure is 300 lb. abs., the value of the high-potential increment of heat for power generation purposes is 1.55 times the average value. Therefore, the actual loss is $1.30 × 1.55 = $14.40 per square foot per year.

The foregoing examples of losses and savings is based on still-air conditions. The effect of air circulation over a bare surface is to increase enormously the rate of heat loss. An air velocity of 10 miles per hour will at least double the rate of loss from such surfaces.

Where heat-loss data are available in terms of B.t.u. per hour, Fig. 2 furnishes a convenient means of converting them to their equivalents in dollars per year of 8,760 hours. Where the period of operation is less than the full year, values from Fig. 2 should be multiplied by the proportionate part of the year represented by the operating period.

The matter of economical thickness of insulation has been made the subject of extensive investigation, and thicknesses are now chosen with assurance that they are really economical—that they are sufficient to provide adequate reduction in heat losses and yet not so thick as to necessitate unjustified first cost. And materials have been developed that may be used with the assurance that they will provide effective results at temperatures far beyond those of present-day steam-plant practice.

But the high-pressure and high-temperature-steam mains represent only a part of the entire piping system of a modern plant. Feed-water piping, auxiliary headers, water-wall circulation piping, connections from boiler nozzles to superheaters, soot-blower piping, drip piping, etc., constitute items less important per unit of area, but when total area is considered, become of major importance in the pipe-insulation problem. Even cold-water lines must be included among the classes of piping requiring insulation if troublesome drip from condensation of moisture from the air is to be avoided.

At the very least, the value of the preheat in the air supplied for combustion is not less than its equivalent in fuel. Actually it must be somewhat more than that. Specifically, its value is equal to the cost of fuel required to replace its effect—the cost of the additional fuel required to produce a given quantity of steam using air at lower temperature, over and above what would be required for the same production with air supplied at the higher temperature.

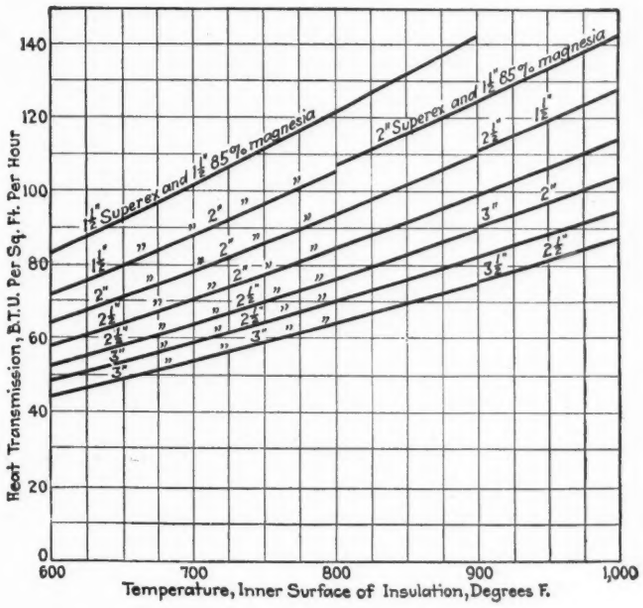


Fig. 4—Extension of Fig. 3 to 1,000 deg. temperature.

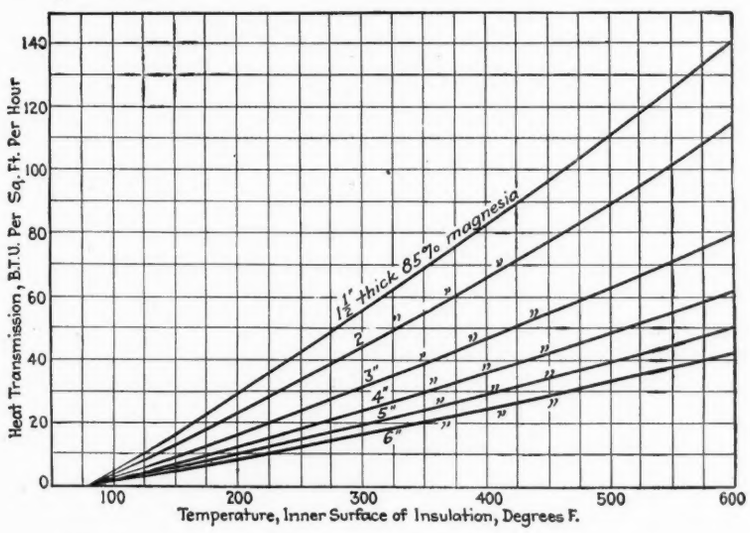


Fig. 3—Heat transmission through insulation on flat surfaces (air temperature 80 deg. F.).

The function of insulation is, of course, to keep the heat in the air once it has been put there, and to maintain its effectiveness by minimizing temperature drop in the air from the time it leaves the preheater until it is admitted to the furnace. The heat conserved is the most valuable portion of the heat content of the air. Again the importance of maintaining temperature head and the higher value of high potential heat are apparent. Figs. 3 and 4 show the heat losses which may be expected from various thicknesses of typical insulating materials.

The data on heat transmission through insulation, given in Fig. 3, for flat surfaces apply to boiler (not to boiler settings, of course) and auxiliary-equipment surfaces with a degree of accuracy sufficient for most engineering purposes, because the radii of curvature are usually quite large.

On both air-cooled walls and water walls of furnaces the savings by insulation are proportionately much greater than on solid refractory walls, and a given thickness of insulation applied to either of these types of walls will bring the total loss down to a point far below what it would be if the same amount of insulation were applied on a solid refractory wall. This is due to the fact that the portion of the heat flow stopped by the insulation is immediately picked up and carried away by the cooling medium, instead of tending to increase the temperaure head back of the insulation, as it does on refractory walls. Where

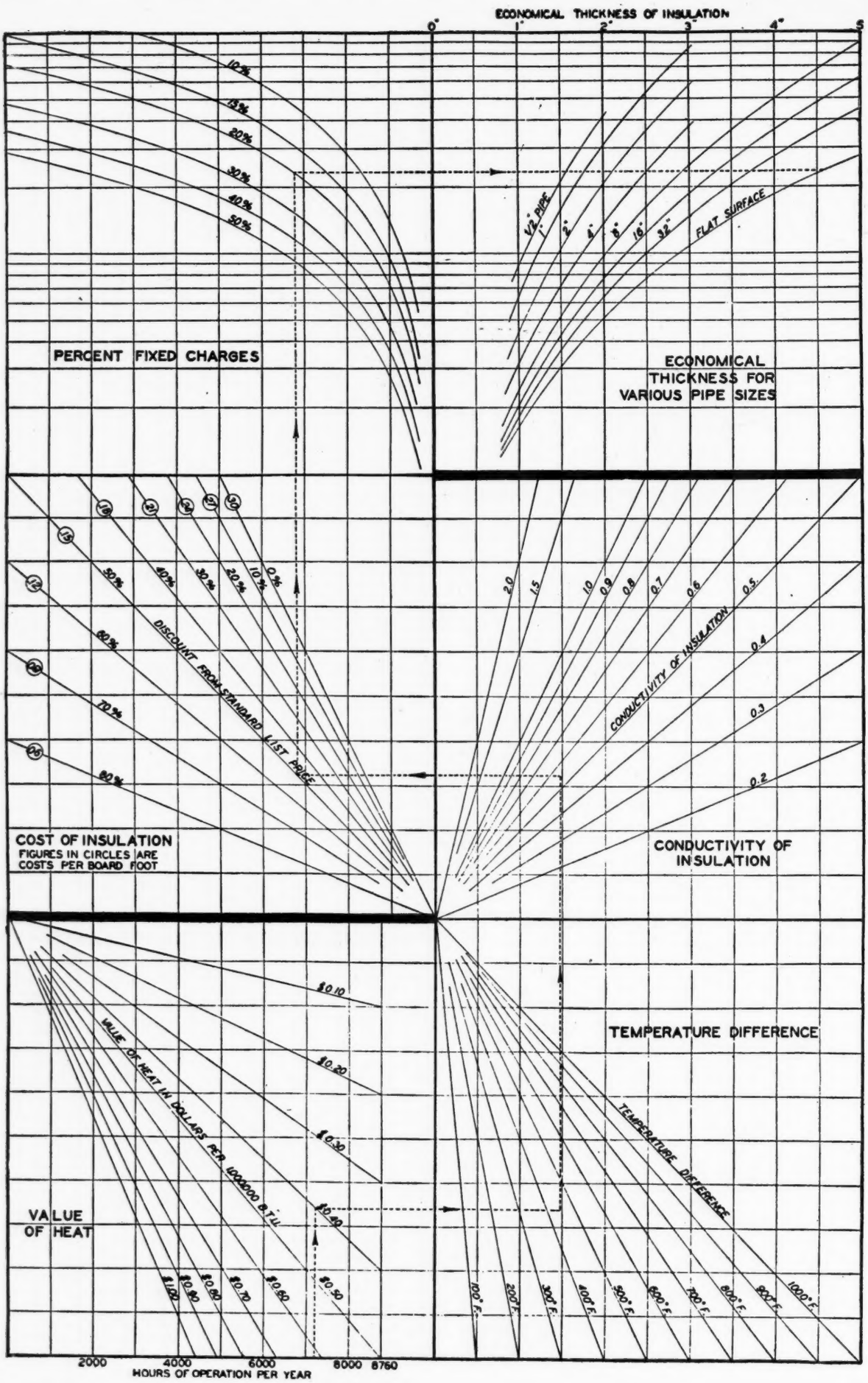


Fig. 5—Chart for Determining Economical Thickness of Insulation.

there are no air preheaters or other means for utilizing the heat in the gases, the principal reason for insulating breechings and flues is to prevent excessive heating of the boiler room. There is also a corollary advantage, however, in the improvement of draft due to the minimizing of temperature drop in the gases before they reach the stack. Also, insulation is often placed inside of the breeching in order to provide a protective lining to guard the steel from corrosion.

Where there are economizers or air preheaters or both, there are still greater advantages resulting from the insulation of uptakes and flues. In such cases the heat saved has a real dollar value, and the maintenance of temperature head increases the effectiveness of heat recovery in the economizer or air preheater.

When the decision has been reached that a given equipment should be insulated, the solution is not yet complete. The question remains as to how effectively it is to be insulated. Among the factors to be considered are, of course, the adaptability of the material to the conditions of temperature and usage to which it will be subjected, its durability, and the relative permanence with which it retains its initial insulating value. However, with these questions decided, there still remains the question as to what thickness would be most effective. Obviously, the greater the thickness the lower will be the heat loss, but as thickness is increased, fixed charges are also increased; therefore, the thickness at which the sum of these two costs is a minimum is that which is most economical.

In an earlier paper [Trans. A.S.M.E., vol. 48 (1926), pp. 1269-1318] the author presented a rational method of determining economical thicknesses of insulation. The chart, Fig. 5, is based upon the equations developed in that paper, but it has been simplified in such a manner that the entire solution may be obtained graphically.

The principal factors involved in determining the economical thickness and the order in which they are taken into account are as follows:

1. Hours of operation per year. (8760 hours for continuous operation.)
2. Value of heat in dollars per 1,000,000 B.t.u. (Not necessarily the average cost of heat, but its value at the given potential.)
3. Temperature difference. (Temperature inside of equipment to be insulated minus temperature of surrounding air.)
4. Conductivity of insulation. (B.t.u. per square foot per degree temperature difference per 1 in. thick per hour.)
5. Cost of insulation, per cent discount from standard list. (Curves are also marked with respective costs per square foot 1 in. thick to provide for materials whose costs are not figured in terms of discount from standard price list.)
6. Per cent annual fixed charges. (Usually about 15 per cent in the classes of work under discussion.)
7. Shape of surface or pipe size. (Curves are given for cylindrical surfaces of various diameters and a curve is also shown for flat surfaces.)

In order to use the chart, start at the lower left-hand corner and proceed to the right to a point representing the given number of *hours of operation per year;* then proceed vertically to the line representing the given *value of heat;* thence horizontally, to the right, to the line representing the given *temperature difference;* thence vertically to the line representing the *conductivity* of the given material; thence horizontally, to the left, to the line representing the given *discount* on that material (or given cost per square foot, board measure); thence vertically to the curve representing the required *per cent annual fixed charges;* thence horizontally, to the right, to the curve representing the given *shape;* thence vertically to the scale at the top of the sheet, where the *economical thickness* may be read off directly. The dotted line on the chart illustrates its use in solving a typical example. The actual thickness used will, of course, be the available commercial thickness nearest to the thickness as read from the chart.

A.S.H. & V.E. Holds Summer Meeting in Canada

Air Conditioning, Unit Heaters, Heat Transfer, Insulation and Temperature Measurement Among the Many Subjects Discussed

IN THE beautiful setting afforded by the Canadian lakes, hills and woods at Bigwin Inn, Lake of Bays, Ontario, the 35th semi-annual meeting of the American Society of Heating and Ventilating Engineers has gone down in history as one of the best-attended and most successful summer meetings ever held by that body. There were registered 143 members, 105 ladies and 56 guests. Many and various subjects were considered at length, and the extended discussions were proof of the excellence of the choice of topics.

The meeting was called to order by President Thornton Lewis, who introduced M. Barry Watson, of Toronto, president of Ontario Chapter of the society. Mr. Watson extended a cordial welcome to the society at this, its first meeting held outside the boundaries of the United States. The first technical paper presented was "Instruments for the Measurement of Air Velocity," by J. H. Parkin. As Professor Parkin was unable to be present at the meeting, the paper was given in abstract by J. J. Aeberle, Chicago. This paper embodied a description of certain anemometers of the pressure type for measuring the velocity of air under low pressures. The construction, characteristics and limitations of the instruments were discussed and the precautions to be observed in their use were described.

In the discussion which followed the presentation of this paper W. A. Rowe, of Detroit, pointed out that frequent and accurate calibration of anemometers is essential and that there is need for a convenient means of calibration, as it sometimes is difficult and inconvenient to send the instrument to a laboratory for calibration. F. C. Houghten, of the A.S.H.V.E. Research Laboratories, stated that the present methods of measuring air velocity are subject to as much as 25 to 40 per cent error, and it was suggested by W. H. Carrier that this subject might well be referred to a committee for a report in the form of a code on air velocity measurement.

The next paper, "Air-conditioning System of a Detroit Office Building," by H. L. Walton and L. L. Smith, was entirely descriptive of the application of air conditioning to sixteen floors and two basements of the Union Trust Building in Detroit. A short descriptive article of this air-conditioning system was published in the Nov. 27, 1928, number of *Power*.

The report of the Committee on the Code for Testing and Rating Unit Heaters was submitted by D. E. French. The committee had endeavored to assemble data for comparison and conclusions, and had therefore conducted tests at the University of Kentucky in collaboration with the research laboratory. The code was drafted and submitted to the Industrial Unit Heaters Association, by whom it has been accepted tentatively with the recommendation, that the methods outlined be used by the manufacturers and suggested changes be submitted for incorporation in a standard code at the next meeting of the society.

Prof. L. S. O'Bannon then presented a paper on "Heat and Air Volume Output of Unit Heaters," which described the tests conducted at the University of Kentucky, comparing two methods of measuring the air volume output, namely, by Pitot-tube measurement, and by the condensate-temperature-rise method. Results of the tests indicated that the two methods agree fairly well, although the general impression is that the two methods cannot agree. This erroneous impression is probably due to lack of accuracy in conducting various previous tests.

The first paper to be presented Thursday was "Errors in the Measurement of the Temperature of Flue Gases," by P. Nicholls and W. E. Rice. The determination of the temperature of the flue gas is an essential operation in all tests of boilers, and it is important that the measurments should be accurate. Errors may arise from a number of causes, which can be broadly divided into: (1) Errors due to inac-

curacies of the thermometer or instruments used with it, (2) errors due to the failure of the thermometer to indicate the true temperature of the gas stream in contact with it, and (3) errors due to the fact that the temperature as measured may not represent the true average of the whole gas stream. The object of this paper was to discuss the second source of errors.

In all the set-ups tested the temperature registered by the themocouple nearest the boiler was higher than those further away, showing that stratification of the gases has more influence than has the exposure of the couples to the cooler surfaces. The tests reported showed that the use of an exposed thermocouple installed, as specified by the boiler testing code of the society and with the flue insulated, will indicate a temperature which will approach that of the true average temperature of the gases.

Prof. F. E. Giesecke then delivered an interesting paper on "Pipe Sizes for Hot Water Heating Systems," which contained a description of tests conducted at the engineering experiment station of the Agricultural and Mechanical College of Texas to secure data that may serve as a basis for tables and graphs from which pipe sizes for hot-water heating systems may easily be determined. It is impossible to have a table of capacities that will hold true in every case. The subject of a critical velocity in hot-water heating pipes may be important and well worth careful study as a separate research project, in connection with additional studies, similar to those described in this paper, which will be necessary before tables can be safely proposed that may be used in the design of two-pipe heating systems.

"Capacity of Radiator-Supply Branches for One and Two-Pipe Systems," by F. C. Houghten, M. E. O'Connell and Carl Gutberlet, dealt with the results of a study of capacity of radiator-supply branches and gave final results on this phase of the study. It was formerly believed that pipes always should be sized below the critical velocity, but recently it has been found desirable to utilize the great capacity above the critical velocity. This has been done with very satisfactory results.

The report of Committee on Interpretation of Code for Rating Low-Pressure Heating Boilers was submitted by L. A. Harding. Revision of Codes 1 and 2 presents a complete heat-balance test code. Performance Test Code 3 is a copy of the code prepared and adopted by a committee of the National Boiler and Radiator Manufacturers Association. All of these codes were accepted and adopted by motion and vote of the membership.

The first paper at the Friday session was "Determining the Quantity of Dust in Air by Impingement," by F. B. Rowley and John Beal. Recent studies have been made and the results reported in this paper, relating to the impingement type of dust determinator. This method has some advantages, such as simplicity, convenience to operate, and also the possibility that the operator may get a better idea of the quality of dust when examined under the microscope.

The final conclusions reached in this investigation were: (1) That the amount of dust taken out of the air by the impingement method depends upon several variable factors. Among these factors are size and shape of nozzle, position of nozzle with respect to the collecting plate and velocity of air through nozzle; (2) the determinations by such a method must necessarily be relative as it is impossible under any conditions to take all dust out of the air nd count it; (3) the size of dust particles in the air varies through a wide range, and it is evident that some minimum size must be selected below which it is not necessary to count the particles. This lower limit may be set with reference to the quality of the air desired; (4) by holding the conditions constant under which the samples are taken, results may be obtained with the impingement type of counter which are reasonably consistent; and (5) there is nothing gained in accuracy by placing nozzles in series.

The paper by Paul D. Close entitled "Five Suggested Methods of Appraising Insulations" created lengthy and lively dicussions. The paper points out that the insulation industry is growing rapidly. New materials are being developed constantly, and the insulation idea is becoming more and more popular through intensive advertising and promotion. Unfortunately, however, the public in general does not have sufficient knowledge of the meaning of the word insulation to be able to differentiate between insulating materials and those not entitled to this classification. The result is that many unwarranted claims are being made by concerns endeavoring to capitalize on the promotional work being done at the expense of an uninformed public.

To establish a fair and equitable basis for comparison, however, does not appear to be an easy matter. In order to encourage further thought on the subject five plans are suggested. The first is based solely on conductivities per inch of thickness. The second is a resistance method taking into account the thickness in which the insulation is intsalled. The third plan is intended to rate insulations according to the extent to which they reduce the rate of heat transmission through a wall or roof, and therefore involves the type of construction, the thickness of insulation and the manner of installation. The fourth scheme would rate insulations according to the cost per unit of resistance, either for the material alone or on an installed basis. The last plan suggests the possibility of appraising insulations according to the return on the investment.

In discussing this paper Mr. Schwein, of Chicago, stated that different insulations can be compared only on the basis of transmission through completed walls. He also questioned the advisability of ruling out those materials with conductivity above 0.6, as the manner of installation has great bearing on the over-all effect. A written discussion by Mr. Lindsay also emphasized the fact that it is difficult to set a standard except by actual test under installed conditions.

The next order of business was the report of the nominating committee, which presented the following slate for officers in 1930: President, L. A. Harding; first vice-president, W. H. Carrier; second vice-president, F. B. Rowley; treasurer, Cecil Farrar; council members, R. H. Carpenter, John D. Cassell, Alfred Kellogg, J. H. Howatt.

James Govan, of Toronto, then presented an interesting and valuable paper on "Time Lag as a Factor in Heating Engineering Practice," in which he proposes that resistance be defined in terms of time required for transmission of a definite quantity of heat under certain conditions. Mr. Govan cited several cases in buildings in Canada which were designed according to factors for heat transmission taken from the guide, and probably, because of the time lag, had considerably more heating surface installed than was absolutely necessary. He predicts that in the near future much more attention will be paid to time lag and its effect on building construction.

The last paper submitted at the meeting was "Over-all Heat Transmission Coefficients by Test and by Calculation," by F. B. Rowley, A. B. Algren and J. L. Blackshaw. It described results of co-operative research work between the research laboratory and the University of Minnesota. One of the important factors in the problem of heat transmission through building materials and insulated walls is that of the relation between the over-all coefficients as obtained by test and as determined by calculation for a built-up wall section.

The results of this investigation show conclusively that reliable over-all coefficients may be obtained by the hot-box method of testing or by calculations, providing the proper coefficients are available. In practice the variation to be expected in the construction of walls will give a much wider range of difference between calculated results and actual results than has been shown by these tests. This is to be expected in any type of construction but a large part of the variation may be eliminated by reasonable care in construction and application of the insulating materials. In the discussion which followed F. C. Houghten pointed out that the infinite number of combinations of building materials makes it impossible to derive over-all coefficients for all of them by test, and this paper tends to eliminate the lack of confidence in the use of the calculating method.

The report of the committee on heating and ventilating garages was submitted by W. H. Carrier. This was a code for safety rather than a garage ventilating standard.

Predrying Hog Fuel

Substantial gains in the over-all efficiency of a boiler can be realized by preheating the entrance fuel with exit gases from the boiler, William A. Struthers, of the Portland Electric Power Company, Portland, Ore., points out in this abstract of the paper that he presented at the engineering section meeting of the Northwest Electrict Light & Power Association, held in Walla Walla, Wash., this spring.

IN ORDER to examine the gains that could be made by predrying hog fuel or preheating the entrance air, let us examine a typical heat balance. For this computation I have endeavored to assume average yearly conditions found around Portland, as shown in Table I. The calculations are shown in Table II, in the first column of which we note that the fuel contains 47 per cent moisture and enters the furnace at the average outside temperature of 55 deg. F. The losses per pound of dry fuel are shown. This column, I believe, approximates the usual condition. Hence the heat absorbed by the boiler has been taken as a standard for comparison.

The second column (Table II,) shows a fuel preheated to 212 deg. F. and with one-half the water evaporated, leaving a fuel of 30.7 per cent moisture. This

TABLE I—ASSUMPTIONS MADE IN CALCULATING HEAT BALANCE

Air and fuel temperature, deg. F.		55
Relative humidity, per cent		70
Analysis of Douglas fir hog fuel	Carbon, per cent	50.3
	Hydrogen, per cent	6.2
	Oxygen, per cent	43.1
	Ash, per cent	0.4
Fuel as fired	Moisture in fuel, per cent	47
	Calorific value per lb. of dry fuel, b.t.u.	8,800
Analysis by volume of flue gas	Carbon dioxide, per cent	15.0
	Carbon monoxide, per cent	0.0
	Oxygen, per cent	5.3
	Nitrogen, per cent	79.7
Exit-gas temperature, deg. F.		600

shows 15.1 per cent greater heat to the boiler. The 25 per cent fuel, also at 212 deg. temperature, shows a gain of 17.7 per cent, while the 10 per cent fuel at the same temperature shows a gain of 22.9 per cent. I doubt if there would be a sufficient heat gradient to carry the evaporation to a product with 10 per cent moisture without prolonging the drying period excessively. But to show that there is enough heat in the gases to evaporate the moisture to 25 per cent, I have computed that this would require 944 B.t.u. The exit gases, when cooled to 212 deg., would give up 965 B.t.u., and there is no reason why even a lower exit-gas temperature could not be used.

In the last column of Table II the fuel is not assumed to be heated or dried, but the incoming air has been assumed to be heated to 550 deg. by the gases which leave the furnace at 600 deg. This shows a saving of 22.1 per cent. To heat the incoming air to 550 deg. requires 1,083 B.t.u., which means that the exit gases would be cooled below 200 deg., because at that temperature they would have lost 1,100 B.t.u.

I do not mean by this computation to say that all this heat can be regained economically. I simply point out the quantity that is available. Thus, from a heat-conservation viewpoint, it makes no difference how the heat is conserved as long as it is returned to do useful work. It is probable that the same amount of heat can be recovered more cheaply in the air preheater than in a fuel dryer. However, before this conclusion is accepted as final, there really should be additional experiments made to secure real cost data on accomplishing the recovery.

A preheated and predried fuel would undoubtedly have some advantages not attained by preheated air. The fuel, being lighter and more easily ignited, would burn much more rapidly. This would make possible larger capacities, if that were desired. Reducing the moisture to 25 per cent would bring a reduction of about 9 per cent in the volume of gases and, of course, a corresponding reduction in velocities through the boiler. It is probable that a lower exit-gas temperature and a higher carbon-dioxide content can be attained.

Some time ago a few laboratory experiments were made to determine, in a preliminary way, the rate of drying and what temperatures could be used. It was demonstrated very quickly that the fuel and gases could not move countercurrent. The hot gases must come in contact with the wet fuel because temperatures of even 350 deg. F. will cause dry fuel to smoke. Also, by this method any sparks in the gases will be smothered in damp fuel. Temperatures up to 700 deg. F. can be used without the slightest danger, on fuel containing above 40 per cent moisture. A laboratory test was made that approximated fuel-gas conditions as nearly as possible. The fuel was placed in a pan suspended from a scale in a hot oven (520 deg). The oven was allowed to cool, and the fuel was constantly stirred and weighed each minute. A 25 per cent product remained after 9 minutes drying. However, we realize that this does not duplicate operating conditions very closely. The degree to which the fuel is agitated in the gases, the temperatures and humidity, all play an important part in the rate of drying.

A Nordstrom drier was installed a few years ago in this district. It was used very little, however, as mechanical difficulties developed. It seemed impossible to get the fuel, especially the fine material, to feed through regularly. It appears to me that the high draft loss when using fine material, as well as the fact that the flue gases cannot be used at their highest temperature, work against its success. At any rate, its failure on fuel in this district seems demonstrated.

The drier designed by Doctor Stafford, of the University of Oregon, has been used successfully for several years to dry wood chips to less than one per cent moisture, with 400-deg. flue gases as a source of heat. It consists of a steel drum, 100 ft. long and 10 ft. in diameter, rotating at 3 r.p.m. The chips are fed in at one end and come out at the other. The gases enter at the same end, but are inside a 4-ft. pipe which rotates with the drum. Every 10 ft. a funnel-shaped opening is left for the gases to pass out into the drum. The drier is well designed for its purpose, but it might be simplified for our problem by leaving out the inside pipe. Some type of cinder cone to recover the fine material from the gases would be necessary.

The size of such a drier, and hence its cost, is largely dependent upon the velocity of the gases that could be used. A velocity that would carry the real fine material in suspension would be all right, because this material would dry almost instantly, but the gas velocity must be low enough so the heat would be given up and so that the large material would not be carried. Very little data on this can be found. It would seem that the possible saving as shown above would justify an expenditure to obtain this needed data.

TABLE II—HEAT-BALANCE CALCULATIONS BASED ON ONE POUND OF DRY FUEL

					Air at 550 Deg.
Per cent water	47	30.7	25	10	47
Weight of water per lb. of dry fuel, lb.	0.887	0.443	0.333	0.111	0.887
Loss due to evaporation of moisture in fuel	1,161.8	510.7	383.9	128.0	1,161.8
Loss due to heat in steam from burning hydrogen	731.0	643.3	643.3	643.3	671.5
Loss due to moisture in air	13.3	13.3	13.3	13.3	1.2
Loss due to heat in dry fuel gases	1,114.0	1,114.0	1,114.0	1,114.0	102.2
Loss due to incomplete combustion	0.0	0.0	0.0	0.0	0.0
Loss due to combustible material in ash	0.0	0.0	0.0	0.0	0.0
Loss due to radiation and unaccounted for	880.0	880.0	880.0	880.0	880.0
Heat absorbed by boiler (by difference)	4,899.9	5,638.7	5,765.5	6,021.4	5,983.3
Total calorific value of 1 lb. dry fuel	8,800.0	8,800.0	8,800.0	8,800.0	8,800.0
Over-all boiler efficiency, per cent	55.7	64.1	65.5	68.4	68.0
Gain over fuel not dried, per cent	.....	15.1	17.7	22.9	22.1

RECENT PUBLICATIONS

MATHEMATICAL TABLES FROM "HANDBOOK OF CHEMISTRY AND PHYSICS." Published by the Chemical Rubber Company, West 112th St. and Locust Ave., Cleveland, Ohio, 1929. Artificial limp leather; 4x6½ in.; 145 pages. Price, $1.

THIS very compact little book contains a rather extensive summary of the formulas of algebra, mensuration, trigonometry, calculus, analytical geometry, logarithms and trigonometrical functions, etc.

SEVEN-PLACE NATURAL TRIGONOMETRICAL FUNCTIONS. By Howard Chapin Ives, C. E. Published by John Wiley & Sons, Inc., New York City, 1929. Flexible binding; 4x7 in., 220 pages. Price, $2.50 net.

IN ADDITION to the seven-place natural trigonometrical functions, from which the book takes its name, there are miscellaneous tables and appendices on the adjustment of engineer's transits and levels, area computation, vertical curves, simple curves, and determinations of latitude, longitude and azimuth. These additional tables and appendices are useful mainly to the civil engineer, but many mechanical engineers will be interested in them and will find the table of natural functions useful for special work requiring a high degree of precision. The book is of convenient pocket size, neatly bound, with rounded corners.

EXHAUST STEAM ENGINEERING. By Charles S. Darling. Published by John Wiley & Sons, Inc., New York City, 1929. Cloth, 6x9 in.; 431 pages; 214 charts and drawings; 46 tables. Price, $7.50.

SCIENCE is international, since natural law acts always and everywhere the same under given conditions. Engineering, on the other hand, is always national to some extent, since it involves the use of available equipment, which necessarily has a national aspect. Fairness to the American reader requires, therefore, that he be informed that this book is British, measuring savings largely in pounds, shillings and pence and describing, largely, makes of turbines, engines, etc., with which he is unfamiliar.

In spite of this slight drawback it is only fair to say that this book offers to the American reader an immense amount of practical information on exhaust-steam engineering. The subject is treated from every angle, starting with a clear presentation of the thermodynamics of steam. Theory is used where necessary or valuable, but the viewpoint of the author is distinctly practical, as shown by the frequency of numerical examples comparing the savings by various methods of operation.

The main stress is properly laid on the industrial plant, where an almost infinite variety of steam and power conditions demands the utmost versatility if the applications are to be properly adjusted to the needs of the individual situation. Nevertheless, much of the material in the book is of direct value to the designers and operators of central stations.

The scope of this book is best indicated by the following list of chapter headings:

I. Thermal Properties and Cycles of Operation.
II. Laws of Thermodynamics and Elementary Thermal Cycles.
III. Heat Ranges for Power and Heating Demands.
IV. Regeneration Cycles.
V. Auxiliary Plant in Heat-Balance Systems.
VI. Back-Pressure Working in Private Plants.
VII. Reheating and Other Considerations.
VIII. Pass-Out Turbines and Engines.
IX. Requirements of Turbines for Industrial Plants.
X. Improved Methods of Back-Pressure Working.
XI. Exhaust Steam Turbines.
XII. Exhaust Steam and Locomotive Design.
XIII. Steam Accumulators.
XIV. Applications of Accumulators.
XV. Rateau Accumulator.
XVI. Dimensioning of Accumulators.
XVII. Examples of Accumulators and Systems With Control Gears.
XVIII. Pipe Systems.
XIX. Steam Distribution Systems for Large Areas.
XX. Works Distribution Systems.
XXI. Capital Expenditure and Fixed Charges in Industrial Power Plants.
XXII. Examples of Modern Back-Pressure Plant Index.

It will be seen from this list that the subjects covered are among the most important confronting plant designers and operators today. Their treatment is designed to give the reader a fund of knowledge with which he can attack his own exhaust-steam engineering problems in an intelligent manner.

STEAM TURBINES. By J. A. Moyer. Published by John Wiley & Sons, Inc., New York City, 1929. Cloth; 6x9 in.; 557 pages. Price, $4.50.

THIS is the sixth edition of this book, which for many years has enjoyed considerable popularity as a text on stationary steam turbines. By adding material on bleeder turbines, data on variation of steam consumption rate with turbine age, new features in the design of casings and multiple exhaust ends of large units, the author has endeavored to bring the book up to date. Although it represents considerable improvement over previous editions, it, nevertheless, contains data that are now out of date. For example, two tables are presented to illustrate steam consumption rates of modern turbines, but the most recent test data reported in them are of 1912. In the chapter devoted to the discussion of turbine government no mention is made of the hydraulic governors now used by one of the prominent manufacturers. There has been practically no mention of recent developments in turbine design for pressures of 1,000 lb. or more, and while bleeder and mixed-pressure turbines are discussed, little has been said of the possibilities of back-pressure units.

FUNDAMENTALS OF THE SMOKE NUISANCE. By Samuel S. Wyer. Prepared for Fuel-Power-Transportation Educational Foundation, 1014 Hartman Building, Columbus, Ohio.

MR. WYER, a consulting engineer, of Columbus, Ohio, lists seven specific reasons why the community suffers a distinct material loss through the smoke nuisance. A blanket formula for relief cannot be laid down, as in each case the abatement of the nuisance revolves about strictly local conditions, not the least of which is the attitude of the citizens and industrial concerns toward co-operation in a smoke-eradication program. The author believes that a real effort to dissipate the pall of smoke that hangs over America's industrial cities will be made only when public opinion, influenced by education and experience, demands it. A number of cartoons from the pen of "Billy Ireland," of the Columbus (Ohio) *Evening Dispatch*, are reproduced in this pamphlet, being an excellent example of one of the ways in which the public may be informed of the harmful effects of smoke on life and property.

CENTRAL ELECTRIC STATIONS IN CANADA, a report published in two volumes, has just been issued as Water Resources Paper No. 55 by the Department of the Interior of Canada. Part I covers the statistics of the industry as at Jan. 1, 1927, and is available for distribution upon application to R. H. Coats, dominion statistician, Dominion Bureau of Statistics, Ottawa, Ont. Part II is the third edition of the directory of central stations as at May 1, 1928, and is issued by the Dominion Water Power and Reclamation Service. This edition, more comprehensive than those previously issued, is an up-to-date summary of the financial and physical structure of all organizations generating or distributing electricity for public use in Canada. The names of all municipalities where electricity is sold are listed, together with the number of customers, prevailing rates, power for sale and transportation facilities available. Copies of Part II may be obtained on application to J. T. Johnston, director, Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa, Ont., Canada.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Huge Power Plant in Swiss Alps

The region above Meiringen, Bernese Oberland, Switzerland, where the Grimsel power works are now being constructed

HYDRO-ELECTRIC installations are now in course of construction near the Grimsel Pass which unites the Rhone Valley with the Valley of the Aare, a tributary of the Rhine. These will, when completed, be the most powerful on the Continent of Europe and will develop a total of 360,000 hp. The different installations, reservoirs, conduits, power stations, etc., will extend for about 12½ miles and will utilize a fall of 3,936 ft. at different levels.

The building of the Grimsel power station naturally necessitates extensive preparations and installations, as for instance the dam, 371 ft. in height and 223 ft. at the base; it will form an artificial lake about 3.1 miles long. This concrete dam will surpass all similar works in Europe, both for height and total cubic contents. It will be completed in twelve months' actual labor; but, as meteorological conditions at these high altitudes only permit of work being carried on during three months in the year, construction of the building has to be spread out over a period of four years.

British National Power Project Progressing Rapidly

The first practical evidence of the great work of the British Central Electricity Board in arranging for the supply of electricity over a nation-wide "grid" system to every part of the country was completed during May. Current has been passed over the first two complete portions of the "grid"—between Glasgow and Bonnybridge and between Bedford and Little Barford. Although it has been in existence for only two years, the board has already placed contracts for over $42,500,000, arranged for the necessary standardization in certain areas at a further estimated cost of $40,000,000, adopted schemes for five areas, covering nearly one-half of the total area of the country, and serving three-quarters of the entire population.

The day is approaching when Britain will have a cheap and abundant supply of electricity. The "grid," or system of main transmission lines, over the first completed part of which current is already passing, will before long stretch out into every corner of the country. Since the passing of the Electricity Act of 1926 and the appointment of the board to reorganize the electricity industry on the generating side, a vast amount of preparatory work has been done. Plans have been adopted for five areas covering 37,656 square miles, out of Great Britain's total area of 88,141 square miles.

The board, on its creation, was confronted with a paradoxical situation. It found that there were over 600 electricity undertakings in the country; but that, while the combined plant was greatly in excess of the total needs, practically every station was too small for the particular requirements of its own area. The board had to select the best stations and to make sure that they have sufficient plant to meet the needs of the huge areas they will serve when the full scheme is in operation. The "grid" of transmission lines will be constructed to join the stations together, so that they may operate as a single system.

Instead of some 600 stations, producing the power required in an expensive and often inefficient manner, the country will be supplied from, say, 150 stations, all working with the best technical methods and using their plant to the highest practical capacity. The plans already adopted by the board cover three-fourths of the entire population of the country. Out of 328 stations now existing in those areas the board has selected 106, and it is estimated that $50,000,000 worth of plant, now standing idle, will be released for revenue-producing purposes.

The construction of the "grid" is proceeding rapidly, and soon the country will be under a complete network of the primary cables, carried on chains of galvanized steel towers. The design of the towers has been decided by the board in consultation with Sir Reginald Blomfield, R. A., and the normal span between each will be 900 ft. While the board is a semi-public body, appointed by the Minister of Transport, it is not a government department and is free to carry out its duties without restrictions which must surround ministerial or political activities.

A.I.E.E. Honors Five Engineers; Lamme Medal to A. B. Field.

Five engineers were honored by the American Institute of Electrical Engineers at its convention held in Swampscott, Mass., June 24-28. Herbert Hoover, Charles F. Scott and Charles F. Brush were elected honorary members of the institute; Allan B. Field received the Lamme medal; and Joseph Slepian was given an award for the

best theoretical paper presented before the institute during 1928-29.

Of those elected to honorary membership, President Hoover was designated as the most outstanding American engineer. Charles F. Scott, head of the Electrical Engineering Department of Yale University and past president of the A.I.E.E., was praised for his work as an inventor and engineer. Charles F. Brush, scientist and recipient of the Edison medal, died on June 15, at which time he was being balloted upon by the directors of the institute. His name was placed on the list of honorary members for his outstanding research activities.

Allan B. Field
Awarded the Lamme Medal

This year's recipient of the Lamme medal, Allan B. Field, is a prominent English inventor and a consulting engineer for the Metropolitan Vickers Electrical Company, Ltd., of Manchester, England. He received his early education in England, but much of his valuable work was done in the United States, to which he came in 1902, working for various electrical companies before joining Westinghouse in 1909. Among his important works is the solution of problems relating to turbine-generator design. The Lamme medal was created by provisions in the will of the late Benjamin G. Lamme, electrical scientist of note and chief engineer of the Westinghouse Electric & Manufacturing Company. It is given for meritorious achievement in the design of electrical machinery. Friends of Mr. Field in England and the United States were able to listen to the presentation through the short-wave broadcasting set of station KDKA.

Many inventions are attributed to Dr. Joseph Slepian, research engineer, of the Westinghouse company, who received an award for the best theoretical paper. His prize-winning discourse, "The Extinction of an Alternating Current Arc," was presented before the summer convention of the A.I.E.E., June 25-29, 1928, in Denver, Colo. In the paper were incorporated many conclusions reached by Dr. Slepian during his development of the Deion circuit-breaker, which has introduced a radically new method of rupturing alternating currents.

*Spot * News*

STONE & WEBSTER, INC., *prominent for 40 years in many fields of engineering, has just announced the formation of a $100,000,000 corporation in which the public will have a 40 per cent participation. Approximately $57,500,000 of new capital funds will be added to what has heretofore been a privately owned organization.*

* * *

CHICAGO *leads the world in the per capita use of electricity, according to studies made by Dr. Adolph, general manager of the Berlin City Electric Company in Germany. In 1927 it was 1,088 kw.-hr., he reports. Philadelphia averaged 914 kw.-hr.; Detroit, 884; and New York City, 667 kw.-hr.*

* * *

THE CENTENARY *of the death of James Smithson, founder of the Smithsonian Institution, was observed on June 27. In a statement commemorating his death the institution pointed out that Smithson's important bequest to the United States was not merely a sum of money nor an institution, but the idea of scientific research, the very root-idea of modern achievement.*

* * *

NEW ORDERS *for 1,749 steel boilers were placed in May, as reported to the Department of Commerce by 80 manufacturers, comprising most of the leading firms in the industry. This total is slightly greater than that of April, when new orders totaled 1,706, but is below the figure for May, 1928, when 1,836 boilers were ordered.*

* * *

INTERNATIONAL PROBLEMS *arising out of the use of the waters of the Colorado and Rio Grande Rivers will be discussed at the meeting of the International Water Commission in Mexico City, Aug. 20. As all data on the subject have been gathered, important decisions are expected to grow out of this conference.*

* * *

THE ANNUAL REPORT *of the A.I.E.E., submitted June 25 at its convention held in Swampscott, Mass., showed a total membership of 18,133. In addition to three national conventions and three regional meetings, 1,400 meetings were held during the year by the local sections.*

* * *

THE SKILLED TECHNICIAN, *the professional engineer and the artist will all have a part in establishing the new power plant for Eugene, Ore., it has been announced by C. A. McClain, superintendent of the water board, under whose direction the new $2,000,000 project is being completed.*

Diesels to Increase Power Facilities of Mines

With the purchase of two new Nordberg Diesel engines for its copper mines, the Phelps Dodge Corporation becomes the largest user of big Diesel engines in America. It now has in service more than 30,000 hp. of these engines, the first of which, a 1,250-hp. Diesel, was placed in operation in 1917, being the largest Diesel built in the United States at the time. All its other engines are in sizes of 750, 1,250 and 2,250 hp.

The new engines will be rated at 2,250 hp. and will be direct connected to 1,600-kw generators. One of them will be installed at Morenci, Ariz., where there are already five 1,250-hp. Diesels, four of which are driving generators and the fifth directly connected to a 6,400-cu.ft. Nordberg air compressor. When this new engine is installed, it will increase the capacity of the plant to 8,500 hp., making it one of the largest in the country. The other engine is to be installed in the Old Dominion mine at Globe, Ariz., where there are two 1,250-hp. Diesels now.

Benson Boiler Ordered for Langerbrugge Station

An order was placed recently by the Centrales Electriques des Flandres & du Brabant, Belgium, with the Siemens-Schuckertwerke, Berlin, Germany, for delivery of a pulverized fuel-fired Benson boiler to its Langerbrugge station. The capacity of the boiler will be 220,000 lb. of steam per hour at normal rating and 300,000 lb. per hour at peak load. Monsieur Herry, president of the Centrales Electriques, is already well known for his pioneering work in the field of high-pressure steam engineering, since years ago he was the first to erect a central station for operation with 700 lb. steam pressure. By now ordering a Benson boiler for the extension of his plant, he proves again his great confidence in the future development of the highest steam pressures and temperatures.

New England Company Absorbs Two Utilities

The New England Public Service has recently purchased two New Hampshire utilities, the Bethlehem Electric Company and the Lisbon Light & Power Company. These will be operated in the future by the New Hampshire Public Service Company. Both companies are located in the valley of the Ammonoosuc River in the heart of the White Mountain hotel and resort district. The Bethlehem company renders electric service in Bethlehem, Whitefield, Carroll and Jefferson, N. H. It obtains energy from a combined hydro-electric and Diesel engine plant with a total generating capacity of 525 kw. The Lisbon company serves the towns of Lisbon, Franconia and parts of Bath and Landaff, N. H.

News of Canada

Record Production of Canadian Coke May Affect U. S. Coal Exports

By Camppell Bradshaw
Toronto, Canada

WITH the release of figures showing the production of coke in Canada to have attained a new high level in May, 1929, with an output of 230,739 tons, the dependence of Quebec and Ontario, the "acute fuel area," on the United States, is again being assailed as unsatisfactory. Exports to Canada for the five-month period ended June 1 last were: anthracite, 1,159,322 tons; bituminous, 4,315,707 tons; lignite, 7,286 tons—a total from United States coal fields of 5,482,315 tons. In the same period the exports of Great Britain to the Dominion were but 149,570 tons, principally anthracite; and the total production of Canada 7,395,451 tons, of which 5,883,538 tons were bituminous and the remaining 1,511,913 tons lignite, not a pound of anthracite being mined in the period under review.

It is this dependence of the Dominion on the United States product that Charles Camsell, chairman, Dominion Fuel Board, deplored in his foreword to the report of J. L. Landt, consulting engineer, on the fuel situation of Canada as "one of the most unsatisfactory situations in the life of the country, because in recent years the supply of this coal has been uncertain, its price has shown marked increase, and its quality has gradually deteriorated." The urgent phase of the fuel problems of Canada is, of course, the fuel supply of Ontario and the western part of Quebec, Nova Scotia, New Brunswick, Alberta and British Columbia, all being producers of coal to a greater or lesser degree.

In seeking a solution the fuel board concludes the most promising field for investigation lies in the use of by-product coke in the area affected; it being believed such a substitute would extend the market for Nova Scotia coal, relieve the two provinces from their dependability on United States imports and provide a fuel of equal quality at a reduced price. Mr. Landt's report showed conclusively that all the objects indicated would be attained by the building of byproduct coke ovens at points where the existing demand for gas is sufficient to warrant the erection of such plants.

To arrive at the potential market the reports of dealers in seven of the leading cities were obtained, to ascertain the amount of coke likely to be consumed, the approximate requirements being:

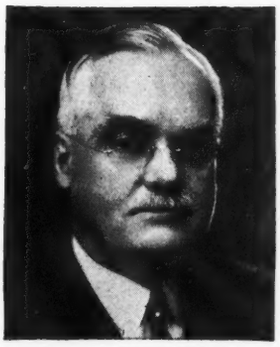
	Tons
Quebec	121,000
Montreal	870,000
Ottawa	322,000
Toronto	720,000
Hamilton	260,000
Port Colborne	135,000
London	200,000

The industrial market for coke in the two provinces can be divided into several classes, such as:

	Tons
Mining, milling refining	87,000
Foundries and machine shops	115,000
Carbide	32,000
Blast furnaces	150,000
Miscellaneous	25,000

Following publication of this report and of the warning that "Canada must look for a substitute for anthracite, since exports of this coal from the United States cannot continue indefinitely," there was talk of a 100,000-hp. plant in Toronto, a project which died "mysteriously" with the preparation of preliminary plans. As a result, despite the end of hydro development in certain sections of Ontario at least, having been reached, the importation in the first five months of the current year of 5,482,315 tons of coal from the United States alone, shows the independence of the "acute fuel area" as regards supplies, to be as far off as ever—and a United States embargo on anthracite as certain in the future as is the present lack of control of supply and price.

Men in the News



HAROLD B. SMITH,

professor of electrical engineering, Worcester Polytechnic Institute, and consulting engineer, Westinghouse Electric & Manufacturing Company, was elected president of the American Institute of Electrical Engineers at the annual meeting of the Institute held at Swampscott, Mass., June 25. The other officers elected were: vice-presidents—E. C. Stone, Pittsburgh, Pa.; W. S. Rodman, Charlottesville, Va.; Herbert S. Evans, Boulder, Colo.; C. E. Fleager, San Francisco, Calif.; C. E. Sisson, Toronto, Ont. directors—J. E. Kearns, Chicago, Ill.; W. S. Lee, Charlotte, N. C.; C. E. Stephens, New York, N. Y. National treasurer, George A. Hamilton, Elizabeth, N. J. (re-elected).

Record Manufacturing Activity During First Half of 1929

The first half of 1929 has witnessed the greatest manufacturing activity in the history of the country. The average rate of production for general manufacturing during the six months period was about 13.4 per cent nigher than for the same period last year and about 16.6 per cent over the first half of 1927. The peak of operations, after corrections are made for seasonal variation, appears to have been reached in May, although the final figures for June may place that month in the lead. The actual rate of operations without adjustment for seasonal influences, however, was recorded in February.

As for the immediate future favorable economic factors outweigh the unfavorable, and the third quarter of 1929 should witness productive operations relatively greater than during the same period last year, although some recession from the current high operations is now in sight.

Obituary

Worcester R. Warner, past president and honorary member of the A.S.M.E. and a member of the Warner & Swasey Company, died June 25 at Eisenbach, Germany, following a heart attack. He was 83 years old.

Born in Cummington, Mass., Mr. Warner started his engineering career at the age of nineteen, when he secured employment in Boston with George B. Brayton, one of the most eminent mechanical engineers of his time. For three vears he assisted Mr. Brayton in the design and construction of Brayton boilers and engines. In 1881 he associated himself with Ambrose Swasey, establishing the machine-tool firm of Warner & Swasey in Cleveland, Ohio. This later became the firm of Warner & Swasey Company, which, through Mr. Warner's knowledge of astronomy, manufactured many of the largest telescopes in existence.

In addition to his membership in the A.S.M.E., Mr. Warner was past president and honorary member of the Cleveland Engineering Society, a fellow of the American Association for the Advancement of Science and a trustee of the Case School of Applied Science.

William S. Andrews, a pioneer in the development of electricity and a coworker with Thomas A. Edison almost from the day Edison invented the electric incandescent lamp, died at Schenectady, N. Y., July 1, at the age of 82.

Andrews assisted in winding the armature of Edison's first dynamo, constructed the first Edison chemical electric meter, made the first molds for the carbonizing of lamp filaments, and invented several delicate mechanisms necessary for the manufacture of light bulbs. He was continuously connected with the light, power, and X-ray branches of electricity since 1879.

Born in 1847 in Saltford, England, he was educated principally in Cuzner's Collegiate Academy, near Bath, where he showed such mechanical talents that he was made head master of the school at eighteen. After ten years, however, he emigrated to the United States, where he obtained a position with Edison at Menlo Park. In 1883, as chief electric engineer of the Edison Light Company, Andrews installed the early generating stations in Chicago, New Orleans, Minneapolis, Des Moines, Rochester, N. Y., and Sunbury, Pa.

At his death Andrews was the General Electric Company's oldest employee, having been recognized as one of the nation's foremost experts even before that concern was organized.

JAMES HYSLOP, 60 years old, assistant station engineer with the Ontario Hydro-Electric Power Commission, died on June 19 at his home in Toronto, Canada. Familiar with every phase of sub-station design, Mr. Hyslop's services were much in demand since he entered the employ of Ontario's foremost public utility. Born in Scotland, he came to America in 1892, settling first in Chicago, which city he left for Winnipeg in 1911.

PERSONALS

D. W. WILSON has resigned his position as vice-president of the Dry Quenching Equipment Corporation to take charge of engineering work for the M. W. Kellogg Company. Mr. Wilson began his new work at Jersey City, N. J., last month.

EDWARD C. BROWN has recently been elected vice-president and eastern manager of the Dearborn Chemical Company, and will be in charge of the New York Office and Eastern Department. Mr. Brown was formerly foreign manager of the company, and has been in Buenos Aires for the last sixteen years. W. M. CAMPBELL will succeed Mr. Brown in the Buenos Aires office. The promotion of Mr. Brown was occasioned by the resignation of GRANT W. SPEAR, who has served as vice-president and eastern manager for the past twenty years.

THORNTON LEWIS, president of the American Society of Heating and Ventilating Engineers, attended and spoke at the annual convention of the Heating and Piping Contractors National Association, held in St. Louis, June 10-13.

H. A. MORRISON, mechanical engineer for Lever Brothers Company, Cambridge, Mass., and H. F. SCOTT, plant engineer for the Dennison Manufacturing Company, Framingham, Mass., were recently elected members of the executive committee of the Boston Section of the American Society of Mechanical Engineers for a three-year term.

Coming Conventions

American Institute of Electrical Engineers. Pacific Coast Regional Meeting, Santa Monica, Calif. Sept. 3-6. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Welding Society. Fall meeting at Cleveland, Ohio, Sept. 9-13. Secretary, M. M. Kelly, 33 West 39th St., New York City.

National Association of Power Engineers, 47th annual convention, Chattanooga, Tenn., Sept. 9-13. Fred Raven, secretary, 417 South Dearborn St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

Universal Craftsmen Council of Engineers. Annual meeting in Detroit, Mich., Aug. 6-10, at the Book-Cadillac Hotel. Grand Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

BUSINESS NOTES

COMBUSTION ENGINEERING CORPORATION announces three changes effective July 1, in its Southern District offices. The territory previously known as the Atlanta district, has been divided into three sections, served by offices located in Charlotte, N. C., Atlanta, Ga., and New Orleans, La., as follows: T. W. Battle has been appointed district manager of the Charlotte territory, with offices at 919 Johnston Bldg.; I. S. Forde has been appointed acting district manager of the Atlanta territory, to succeed T. J. Cleary, resigned, with offices at Candler Bldg.; and E. C. Walthall has been appointed district manager of the New Orleans territory, with offices at 2118 Union Indemnity Bldg. The district offices at Memphis, Tenn., and Houston, Texas, will continue to serve the same territories as in the past.

J. T. DONALD & COMPANY, LTD., of Montreal, Que., has established a new department specializing, among other problems, in water purification, filtration and corrosion. James O. Meadows, B. Sc., A.M.E.I.C., will have supervision over the new department.

CARRIER ENGINEERING CORPORATION, of Newark, N. J., has announced the opening of an engineering and sales office in the Buhl Building, Detroit, under the direction of Herbert Peacock, who leaves his position of an engineering assistant with the same company to take charge of the Detroit territory.

CHAIN BELT COMPANY, of Milwaukee, Wis., announces the transfer of R. T. Steindorf to its Cleveland Office, at 200th St. and St. Clair Ave.

MODERN ENGINEERING COMPANY, of St. Louis, Mo., has announced the appointment of the Modern Engineering Company, of Louisville, Ky., as its representative in the Louisville section, and of the Sales Engineering Company, of Milwaukee, Wis., to handle its products in that state.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.35 @$2.40
Kanawha.....	Columbus.....	1.25 @ 1.50
Smokeless.....	Cincinnati.....	1.75 @ 2.00
Smokeless.....	Chicago.....	1.75 @ 2.25
S. E. Kentucky...	Chicago.....	1.35 @ 1.60
Steam.....	Pittsburgh.....	1.55 @ 1.65
Gas Slack.....	Pittsburgh.....	1.00 @ 1.15
Big Seam.....	Birmingham....	1.50 @ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.50@$2.75
Barley.....	New York.....	1.50

FUEL OIL

New York—July 3, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—June 26, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.395 per bbl. or 42 gal.; 26@28 deg., $1.445 per bbl.; 28@30 deg., $1.495 per bbl.; 30@32 deg., $1.545 per bbl.; 32@36 deg., gas oil, 4.48c. per gal.; 38@40 deg., distillate, 5.23c.

Pittsburgh—July 2, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5.5c. per gal.

Philadelphia—June 29, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—June 25, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—June 29, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 62.5c. per bbl.; 26@30 deg., 70c. per bbl.; 30@32 deg., 95c. per bbl.

Boston—July 1, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.45c. per gal.; 28@32 deg., 5.52c. per gal.

Dallas—June 29, f.o.b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

TRADE CATALOGS

IMMERSION HEATERS—Four general types of direct-immersion liquid-heating units are described and several commercial installations pictured in a recent leaflet, No. 214-A, of the General Electric Company, of Schenectady, N. Y.

TILE—The Standard Arch Company, of Frostburg, Md., has just published a twenty-page illustrated catalog describing flat-suspended roof construction and sectionally supported side wall construction for all types of boilers, kilns, and industrial furnaces.

HYDRAULIC TURBINES—Bulletin 1644, just issued by the Allis-Chalmers Manufacturing Company, of Milwaukee, Wis., is a well-illustrated 74-page review of hydraulic turbines and auxiliaries for low, medium and high heads.

MECHANICAL STOKERS—The Stoker Manufacturers Association, of Detroit, Mich., has issued a revised edition of their Condensed Catalog of Mechanical Stokers. This 36-page publication describes and illustrates the 46 different types of stokers manufactured by the ten members of the association.

GAS BOOSTERS—A description of Victor Gas Boosters is featured in Bulletin No. 233, recently issued by the Connersville Blower Company, of Connersville, Ind., to supersede its Bulletin No. 33. Tables which designate the capacities of the different sizes and types of boosters are included.

RECORDING VOLTMETERS AND AMMETERS—A description of the new small sized recording voltmeters and ammeters now being manufactured by The Bristol Company, of Waterbury, Conn., is contained in their Bulletin No. 373. Illustrations of the new meters are a feature of the bulletin.

MOTORS—A brief description, with illustrations, of the equipment used in a gearless traction elevator motor and variable control system, together with its operating characteristics, is given in Leaflet 334, issued by the General Electric Company, of Schenectady, N. Y. The control, by measured performance, of all types of motors through a recording instrument is explained in Leaflet GEK-52, also published by the General Electric Company.

VALVES—Forged steel gate, globe, angle and check valves with fittings for all high-pressure and temperature work are fully discussed and illustrated in a 24-page booklet, No. 213, just issued by the Crane Company, 835 South Michigan Ave., Chicago, Ill.

GROUND TESTING—"Who's Who in Ground Testing" is the title of Bulletin 1245, just issued by James G. Biddle, 1211-13 Arch St., Philadelphia, Pa. This twenty-page booklet gives the experiences of some of the users of the "Megger" ground tester.

CONDENSERS—Down-flow and radial-flow surface condensers and steam-jet air ejectors, for marine use, are described in Bulletin DMF-5174, illustrated, lately published by Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Piedmont — Owner, c/o Slocomb & Tuttle, 337 17th St., archts., plans are being made for a hotel at Bonita Vista, Highland and Vista Aves. Estimated cost $1,000,000.

Calif., Santa Monica — Bay Cities Guaranty Building & Loan Co., 225 Santa Monica Blvd., awarded contract for a 13 story office building at Santa Monica Blvd. between 2nd and Third Sts., to Orndorff Construction Co., Bank of Commerce Bldg., Los Angeles. Estimated cost $500,000. Steam heating system, electric elevators, etc., will be installed.

Conn., Stamford—Stamford Hall Sanitarium, 70 Summer St., is having plans prepared for the construction of a 75 x 125 ft. power plant to include three 150 hp. boilers and three stokers on Bedford St. Estimated cost $50,000. Fletcher-Thompson Inc., 542 Fairfield Ave., Bridgeport, are engineers.

Ga., Atlanta—Bureau of Yards & Docks, Navy Dept., Arlington Bldg., Washington, D. C., will receive bids until Aug. 6 for the construction of a group of buildings including refrigeration plant for U. S. Veterans Hospital here.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., plans the construction of a 60 x 80 ft. electric sub-station at 117 North Dearborn St. Holabird & Root, 333 North Michigan Ave., are architects.

Ind., Indianapolis—Meridian & Maryland Co., c/o D. A. Bohlen & Son, Majestic Bldg., Archts. awarded contract for the construction of a 9 story office building to Leslie Colvin, 823 Continental Bank Bldg. Estimated cost $1,000,000.

Ill., Chicago—J. H. Murphy, 1531 Blackhawk St., awarded contract for the construction of a 67 x 123 ft. power plant and dryer building to McKeown Bros., 112 West Adams St.

Ill., Chicago—Trustees System Discount Co., 63 Adams St., will soon award contract for a 32 story office and stores building at Wells and Lake Sts. Estimated cost $2,500,000. Thielbar & Fugard, 219 East Superior St., are architects.

Ill., Chicago—L. F. Urbain, 1254 Lake Shore Dr., Archt., will soon receive bids for the construction of a 16 story apartment building at 6230 Kenmore Ave. for Syndicate, c/o architect. Estimated cost $1,600,000.

Ia., Cedar Rapids—City will receive bids until July 11 for waterworks improvements including pumping station and filter buildings. Alvord, Burdick & Howson, 1417 Hartford Bldg., Chicago, Ill., are engineers. Former bids rejected.

Ia., Shenandoah — Iowa-Nebraska Light & Power Co., has been granted franchise for extensions and improvements to plant. Estimated cost $200,000.

La., New Orleans—Public Service Inc., Baronne St., is having plans prepared for the construction of a 2 story, 72 x 150 ft. electrical building on Tulane Ave. Estimated cost $200,000. Private plans.

La., New Orleans — Tulane University, awarded contract for the construction of a 9 story medical building including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc. to G. J. Glover Co. Inc., Whitney Bank. Estimated cost $1,000,000.

Md., Laurel—D. C. Commissioners, Washington, D. C., awarded contract for alterations to power plant at D. C. Training school near here to English Construction Co., 1311 H. St. N. W., Washington, D. C.

Mass., Northampton—Clark School for Deaf, A. T. Phillips, Round Hill Rd., awarded contract for the construction of an 80 x 85 ft. boiler house to M. I. O'Connor, 696 Bridge St.

Mich., Alma—Michigan Masonic Home, plans the construction of a home including steam heating system, boilers, etc. Estimated cost $800,000. Osgood & Osgood, Monument Sq., Bldg., are architects.

Mich., Detroit—Bd. of Education, C. A. Gadd, Bus. Mgr., 1354 Broadway, will soon award contract for the construction of a power house at Linwood Ave. Estimated cost $80,000. Malcolmson & Higginbotham, 1217 Griswold St., are architects.

Mich., Lansing—J. T. Watkins, 600 Dinsmore Dr., plans the construction of a 10 story apartment building, including steam heating system, boilers, elevators, etc. on Walnut St. Estimated cost $750,000. Architect not announced.

Mich., Monroe—St. Mary's Academy, plans the construction of a group of buildings for Girls Academy including steam heating and ventilation systems, boilers, etc., on Elm St. Estimated cost $1,000,000. D. A. Bohlen & Son, 1001 Majestic Bldg., Indianapolis, Ind., are architects.

Mo., St. Louis—Mallinckrodt Chemical Works, 3800 North Second St., awarded contract for the construction of a boiler house to Woerman Construction Co., Syndicate Trust Bldg. Estimated cost $75,000.

Mo., St. Louis — Union Electric Light & Power Co., 12th and Locust Blvds., awarded contract for addition to and remodeling of substation at 3916-22 Enright Ave. to Fruin-Colnon Contracting Co., Merchants-Laclede Bldg.

Neb., South Sioux City—City will receive bids about August 1 for sewage treatment work including two pumping stations, etc. Estimated cost $100,000. W. E. Buell & Co., Insurance Exchange, Sioux City, Ia., are engineers.

Nev., Hawthorne—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will soon award contract for the construction of a group of buildings including refrigeration plant etc. at Arsenal here. Estimated cost $1,844,447.

N. J., East Orange—Oraton Realty Co., c/o Warren & Warren, 31 Clinton St., Newark, Archts., is having preliminary plans prepared for the construction of a 6 story hotel including steam heating system at 499 William St. Estimated cost $500,000.

N. J., Hackensack—P. J. Jossier, 240 Broad Ave., Palisade Park, Archt., will receive bids about Aug. 1 for the construction of a 5 story apartment building, including steam heating, and refrigeration systems, boilers, elevators, etc., on Prospect St., here, for owner, c/o architect. Estimated cost $500,000.

N. J., Hillsdale — Dept. of Institutions & Agencies, State Office Bldg., Trenton, will soon award contract for the construction of a power house at Hillsdale Hospital here. Estimated cost $50,000. C. N. Leathem, Jr., State Office Bldg., Trenton, is architect.

N. J., Kearny—Delaware Lackawanna & Western R.R., 90 West St., New York, N. Y., will not construct power house along Hackensack River. Estimated cost $4,250,000. Project abandoned. Owner will buy power from Public Service Electric & Gas Co.

N. J., Pinewald—Sangor Hotel Corp., B. W. Sangor, Pres., 60 Park Pl., Newark, will soon award contract for the construction of an 8 story hotel including steam heating ventilation and refrigeration systems, boilers, elevators, etc. at Crystal Lake Shore. Estimated cost $1,000,000. W. K. Oltar-Jevsky, 130 West 42nd St., New York, is architect.

N. J., South Amboy—Jersey Central Power & Light Co., 20 South St., Asbury Park, awarded contract for the construction of a power plant on Waterfront on Junction to Deakman Wells Co., 921 Bergen Ave., Jersey City. Estimated cost $5,000,000.

New Mexico — San Luis Valley Southern Railway Co., G. T. Kearns, V. Pres. and Gen. Mgr., San Acacio, Colo., will soon award contract for the construction of 18¼ mi. railroad including depot buildings, wells, pumping plants, engine house, etc.

N. Y., Brooklyn—Brownsville and East New York Hospital, Ave. A. and Rockaway Parkway, plans the construction of a 2 story, 66 x 72 ft. boiler room and laundry. Estimated cost $40,000. E. N. Adelsohn, 16 Court St., is architect.

N. Y., Buffalo—Lasser-Preyer Inc., Prudential Bldg., will soon award contract for the construction of a 12 story hotel at Huron and Delaware Aves. Estimated cost $1,500,000. Townsend & McNeill, Dun Bldg., are architects.

N. Y., Elmira—Syndicate, c/o E. J. Lazarus, plans the construction of an ice manufacturing and cold storage plant. Estimated cost $150,000.

N. J., Emerson — Bd. of Council, Borough Hall, is having preliminary plans prepared for the construction of a sewage disposal plant and pumping station. Estimated cost $250,000. T. H. Bowe, 110 William St., New York, N. Y., is engineer.

N. Y., New York—Halley Construction Co., E. P. Halley, Pres., will build a 6 story apartment building at Nagle Ave. and Sickles St. Estimated cost $1,000,000. E. Weck, 343 Madison Ave., is architect. Work will be done by separate contracts.

O., Akron — DeWitt Hotel Co., T. Dewitt, V. Pres. and Gen. Mgr., c/o Tollenden Hotel, Cleveland, plans the construction of an 18 story hotel at Main and State Sts., here. Estimated cost $3,500,000. Architect not announced.

O., Cleveland—City, W. R. Hopkins, Mgr., awarded contract for the construction of a 40 x 82 ft. boiler house at Hudson Farm to Burt Shields Co., Citizens Bldg. Estimated cost $29,000.

O., Columbus—Boyajohn & Barr, 299 South Park St., will build a 5 story apartment building on East Broad St. Estimated cost $1,000,000. W. F. Bennett is architect.

O., Springfield—Bd. of Trustees, City Hospital, Clifton and East Sts., is having preliminary plans prepared for the construction of an 8 story hospital. Estimated cost $1,000,000. Berlin & Swern, 228 North La Salle St., are architects.

Okla., Enid—Youngblood Hotel Co., awarded contract for the construction of a 14 story hotel on Main St. to D. C. Bass. Estimated cost $1,000,000. Steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc. will be installed.

Ore., Portland—Meyer Frank Co. plans the construction of a store building including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc., at 6th and Morrison Sts. Estimated cost $2,000,000. DeYoung, Rosenburg & Moscowitz, 11 East 44th St., New York, are architects.

Ore., Portland — Selling Hirsch Sichel Co., plans the construction of a 27 story office building including steam heating and ventilation systems, boilers, pumps, elevators, etc. at West Park and Washington Sts. Estimated cost $1,600,000. A. E. Doyle & Associates, Pacific Bldg., are architects.

Pa., Philadelphia—Owner, c/o C. E. Oelschlager, 1615 Walnut St., awarded contract for the construction of an 18 story apartment building at 36th and Chestnut Sts. to Graham-Chambley Co., 3649 Filbert St. Estimated cost $1,300,000. This corrects report in June 11th issue.

Pa., Pittsburgh — Duquesne Light Co., 435 6th Ave., has work under way on the construction of a power house at Brunots Island. Estimated cost $1,904,000. Byllesby Engineering & Management Corp., 105 West Adams St., Chicago, Ill., is engineer.

R. I., East Providence—Bradley Hospital, c/o Howe & Church, 1208 Turks Head Bldg., Providence, Archts., awarded contract for the construction of a 2, 3 and 4 story home including power house on Squantum St. to A. W. Merchant Inc., 728 Hospital Trust Bldg.

S. D., Yankton—Yankton College, plans the construction of a group of buildings including heating plant, etc. Estimated cost $650,000.

Texas—Lone Star Gas Co., 1915 Wood St., Dallas, plans the construction of two gas compressor stations at Gainesville and Sipe Spring to include equipment in connection with proposed pipe line. Private plans.

Tex., Abilene—Mid-Texas Oil & Gas Co., Mid-Texas Refining Co. and Mid-Texas Pipe Line Co., J. Sloan, Pres., plan the construction of a booster pumping plant, etc. in connection with proposed pipe line and oil refinery. Private plans.

Tex., Abilene—West Texas Public Utilities Co., awarded contract for the construction of a power house on Concho River near here, to W. E. Callahan Construction Co., Kirby Bldg., Dallas. Estimated cost $800,000.

Tex., Ballinger—City, W. V. Northington, is having plans prepared for waterworks improvements including pumping equipment, etc. R. F. Davis, Nacogdoches, is engineer.

Tex., Fort McIntosh—Construction Quartermaster, U. S. Government, will soon award contract for the construction of a sewage booster pumping station, pumping equipment, etc.

Utah, Hyrum—City will receive bids until July 15 for the construction of a hydro-electric plant including equipment, 500 kva. capacity. Estimated cost $70,000.

Wash., Aberdeen—Western Washington Electric Light & Power Co., Stuart Bldg., Seattle, subsidiary of Federal Light & Traction Co., 52 William St., New York, N. Y., awarded contract for the construction of a hydro-electric development on the North River to serve Grays harbor and Willapa harbor areas. Plans include dam, 400 ft. long and 120 ft. high, two 12,500 hp. generating units, 60,000 v. transmission line, etc. to Sanderson & Porter, 52 William St., New York, N. Y.

B. C., Granite — West Kootenay Light & Power Co., Rossland, is having plans prepared for the construction of a dam on Lake Kootenay near here to increase output of 150,000 hp. plant at Bonnington.

Ont., Cobalt—Canadian Northern Power Corp. Ltd., plans the construction of a hydro-electric development on the Montreal River near here to supply power to the mines in Northern Ontario. Plans include power house and dam, 13,000 hp. capacity. Estimated cost $1,000,000.

Ont., Guelph—A. W. Cutten, c/o C. L. Dunbar, Douglas St., is having plans prepared for the construction of a hotel and theatre building, etc. on Wyndham St. Estimated cost $1,000,000. B. H. Marshall, 612 Sheridan Rd., Chicago, Ill., is architect.

Ont., Sarnia—Sarnia Development Co., B. L. Lussier, Hotel London, London, Mgr., awarded contract for a 9 story hotel on Christina St. here, to John V. Gray Construction Co., 1602 Northern Ontario Bldg., Toronto. Estimated cost $550,000.

Steam heating system, etc. will be installed. G. H. Gabler is interested.

Equipment Wanted

Air Compressor, Pumps, etc.—Dept. of Public Works, R. W. Wolfe, Comr., Chicago, Ill., will receive bids until July 10, for motor driven air compressor, three surface type condensate pumps together with miscellaneous equipment, etc.

Boilers — The Koppers Co., Koppers Bldg., Pittsburgh, Pa., is in the market for two 500 hp. boilers for Jones & Laughlin Steel Co's new by-product plant at Aliquippa, Pa.

Ice and Cold Storage Plant Equipment—Port Ice & Cold Storage Co., c/o H. C. Wagener, Corpus Christi, Tex., prices and catalogs on complete equipment for proposed ice and cold storage plant at Corpus Christi. Estimated cost $45,000.

Pumping Equipment — Town of Waterloo, Ont., pumping equipment, etc. for proposed auxiliary waterworks plant. Estimated cost $15,000.

Pumping Equipment—City of Apache, Okla., pumping equipment, etc., for proposed waterworks improvements. Estimated cost $16,000.

Pumping Equipment—City of Hollis, Okla., pumping equipment, etc., for proposed waterworks improvements. Estimated cost $30,000.

Pumps, etc. — Bd. of Aldermen, Port Allen, La., will receive bids until July 30, for two 350 g.p.m. sewage pumps, etc. for proposed sewage treatment plant.

Pumps, Etc.—City of Monroe, Mich., low lift, electrically operated pumps, etc. for proposed waterworks.

Pumps, etc.—City of Ottawa, Ont., will receive bids until July 18 for five sewage pumps, etc., for proposed sewage disposal plant. Estimated cost $100,000.

Pumps, etc.—City of Hinsdale, Ill., is receiving bids for pumps, etc., for proposed sewage disposal plant. Estimated cost $250,000.

Pumps and Motors—City of Kouawa, Okla., deep well pumps and motors for proposed waterworks improvements. Estimated cost $30,000.

Transformers—Dept. of Public Works, City Hall, J. W. Reid, Comr., Detroit, Mich., will receive bids until July 17 for two 24,000 v. 3 ph., transformers for Connors Creek storm water pumping station at Jefferson and Clairpointe Aves. Estimated cost $50,000.

Industrial Projects

Calif., Lodi—PACKING PLANT AND REFRIGERATION PLANT—Vita Fruit Products Co., awarded contract for a 3 story plant including refrigeration plant to Davis-Pearce Co., Stockton. Estimated cost $100,000.

Calif., Los Angeles—BOTTLING PLANT—Sparkletts Bottled Water Corp., 4500 York Blvd., will build a 1 story, 125 x 610 ft. bottling plant at 4500 York Blvd. Estimated cost $100,000. R. D. King, 1124 Van Nuys Bldg., Archt.

Ill., Centralia—SHOE FACTORY—Johansen Bros. Shoe Co., 3640 Laclede Ave., St. Louis, Mo., awarded contract for a 3 story, 45 x 200 and 91 x 57 x 62 ft. shoe factory here, to G. E. Tillman Construction Co., City National Bank Bldg., Centralia, Ill. Estimated cost $80,000.

Ill., Chicago—ELECTRIC APPLIANCE FACTORY—Graham, Anderson, Probst & White, 80 East Jackson Blvd., Archts., will soon receive bids for a 2 story addition to factory at South Menard and Taylor Sts. for Edison Electric Appliance Co., South Menard and Taylor Sts.

La., Sterlington — GAS COMPRESSOR STATION — Arkansas Natural Gas Corp., Shreveport, awarded contract for the construction of a gas compressor station here to Republic Construction Co., Woolworth Bldg., New York, N. Y.

Mass., Dorchester (Boston P. O.)—PLANT ADDITION and BOILER HOUSE—Mason Regulator Co., 1190 Adams St., awarded contract for a 3 story addition to plant and boiler house to Scully Co., 238 Main St., Cambridge. Estimated cost $40,000.

Mass., New Bedford—TOY FACTORY and HEATING PLANT—E. T. Caswell, 570 Pleasant St., will build a 2 story factory, including heating plant and motor operating machinery. Private plans. Work will be done by separate contracts.

Miss., Jackson—FERTILIZER PLANT—F. S. Royster Guano Co., Norfolk Va., awarded contract for a 175 x 400 and 60 x 100 ft. plant to D. J. Rose & Son, Rocky Mount, N. C. Estimated cost $250,000.

N. J.,Newark—PLATE GLASS FACTORIES—Pittsburgh Plate Glass Co., 4 Chester Ave., awarded contract for two 1 and 2 story factory buildings at 53-75 Riverside Ave. to Public Service Production Co., 80 Park Ave. Estimated cost $200,000.

N. J., Trenton — RUBBER FACTORY — Thermoid Co., Whitehead Rd., awarded contract for a 1 story, 100 x 170 ft. factory to W. C. Ehret, Trenton Trust Bldg. Estimated cost $100,000.

O., Cleveland—FACTORY—Reliance Electric & Engineering Co., C. L. Collins, Pres., 1088 Ivanhoe Rd., is having plans prepared for a 1 story, 150 x 180 ft. factory. Estimated cost $150,000. W. H. Hatch, Hippodrome Annex Bldg., is architect.

Pa., Aliquippa — BY-PRODUCTS PLANT, COKE OVENS, BOILER HOUSE, etc.—Jones & Laughlin Steel Co., 311 Ross St., Pittsburgh, awarded contract for the construction of a plant to include 81 coke ovens, by-products and benzoil extensions, coal and coke handling and boiler house extension here to The Koppers Co., Koppers Bldg., Pittsburgh.

Pa., Carnegie — PAPER PRODUCTS FACTORY—Superior Paper Products Co., is having plans prepared for a 1 story, 180 x 360 ft. factory. Estimated cost $150,000. Braziell & Anderson, 309 4th Ave., Pittsburgh, are architects.

Pa., Johnstown—COKE OVENS—Bethlehem Steel Co., awarded contract for the construction of seventy-seven beaker coke ovens and coke handling equipment, to Koppers Co., Koppers Bldg., Pittsburgh.

Tenn., Kingsport — CELLULOSE ACETATE PLANT—Tennessee Eastman Corp., subsidiary of Eastman Kodak Co., 343 State St., Rochester, N. Y., awarded contract for first two units of plant here to Gauger-Korsmo Construction Co., Fidelity Bank Bldg., Memphis, Tenn. Estimated cost $1,000,000.

R. I., Providence—COKE PLANT—Providence Gas Co., 100 Weybosset St., awarded contract for the construction of a 1 story plant of 25 ovens at Allens Ave. and Sassafras Point, to Koppers Co., Koppers Bldg., Pittsburgh, Pa. Estimated cost $500,000.

Ont., Belleville—POWER LAUNDRY—Consolidated Laundries, Ltd., 5350 des Carneres, Montreal, Que., plans the construction of a power laundry. Estimated cost $75,000.

Ont., London — GAS PLANT — Dominion Natural Gas Co., Hamilton, subsidiary of Cities Service Co. and Henry L. Doherty Interests, 60 Wall St., New York, N. Y., plans the construction of a gas plant here, also coke plant at Port Stanley. Estimated cost $2,000,000 and $3,000,000 respectively.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

PRICES of power plant and electrical supplies are unchanged from June levels with a few outstanding exceptions, namely, a decline in armored cable and advances in linseed oil and babbitt metal. No. 14, solid, 2 cond., cable is down $1 per thousand feet ($29) at principal buying centers in the East. Linseed oil rose 0.5c. per lb. to 11.7c. at New York and Chicago. Genuine, highest grade babbitt metal advanced 1c per lb. (2c) at New York warehouses.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 60c. per ft.
Common, 2½-in., cotton, rubber-lined, 80c. per ft., list, less		50%
	Air—Best grade	
¾-in., per ft	3-ply....$0.30	4 ply....$0.36
	Steam—Discounts from List	
First grade....40%	Second grade.....45%	Third grade....50-10%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade.....50% Second grade.....60%

LEATHER BELTING—List price, 24c. per lin.ft., per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	30-10%
Heavy	30- 5%

RAWHIDE LACING—For cut, best grade, 30-5%; 2nd grade, 45-5%. For laces in sides, best, 57c. per sq.ft.; 2nd, 52c., net. Semi-tanned, cut, 30-5%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Asbestos for high-pressure steam, ⅛ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts from list at New York warehouses are as follows:

85% magnesia, high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25 per bbl., without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.30 per 100 lb. in lots up to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00
Colored	9.00@13.00	12.00	12.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed white wipers, as follows:

Chicago (100 lb. bales)	$0.16
New York (100 lb. bales)	.16
Cleveland (per thousand)	38.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Cleveland	Chicago
Per pound	$0.117	$0.11	$0.117

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York:

	Dry	In Oil
Red	$13.75	$15.25
White	13.75	13.75

RIVETS—The following quotations apply on fair-sized orders from warehouse:

Tank rivets, ⅞-in. diameter and smaller, list (Apr. 1, 1927) less 60% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ½-in., round head, per 100 lb.:

New York	$4.50*
Chicago	4.00
Pittsburgh mill	3.10

*Price is for full packages; broken package lots are $6.00 net, delivered.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50%, Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50%, Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa	per M	43.00
Clay brick, 1st quality, 9-in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	62.00
Commercial genuine, intermediate grade	45.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.00

COLD DRAWN STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.50	$3.65	$3.60
Flat or square	4.00	4.15	4.10

BOILER FITTINGS—F.o.b. warehouse, Jersey City, N. J., discounts from list:

Copper ferrules	70%
Boiler flanges	65–5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following basing discounts from list are for large mill lots at Pittsburgh mill:

BUTT WELD

	Steel Black	Steel Galv.		Iron Black	Iron Galv.
Inches			Inches		
1 to 3	62%	50½%	1 and 1¼	31%	15%

LAP WELD

2	55%	43½%	2	23%	9%
2½ to 6	59%	47½%	2½ to 3½	28%	13%
7 and 8	56%	43½%	4 to 6	30%	17%
9 and 10	54%	41½%	7 and 8	29%	16%
11 and 12	53%	40½%	9 to 12	26%	11%

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60%	49½%	1 to 2	34%	18%
2 and 3	61%	50½%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53%	42½%	2	29%	13%
2½ to 4	57%	46½%	2½ to 4	34%	20%
4½ to 6	56%	45½%	4½ to 6	33%	19%
7 and 8	52%	39½%	7 and 8	31%	17%
9 and 11	45%	32½%	9 to 12	21%	8%
11 and 12	44%	31½%			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouses on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3¼	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

These prices are net, per 100 ft., based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller	5c. per cut.	3 in.	9c. per cut.
2¼ and 2½ in.	6c. per cut.	3¼ to 4 in.	10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M. Ft.	Three Cond. M. Ft.	Two Cond. Lead M. Ft.	Three Cond. Lead M. Ft.
No. 14 solid	$29.00 (net)	$40.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:		Lead Covered
Less than coil lots	50%	30%
Coils to 1,000 ft.	60%	35%
1,000 to 5,000 ft.	65%	38%
5,000 ft. and over	67%	40%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS,** per 100 pieces, extra f.o.b. New York warehouse. Discount of 5 per cent. for payment in 10 days. No delivery charges, regardless of quantity.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
½	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
¾	72.07	78.63	10.21	11.63	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224.85	245.94	50.13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508.50	218.74	246.10	41.59	45.01
3½	585.30	37.74	483.04	543.46	55.46	60.02
4	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less Than $10 List	$10 List to $100	$100 List and Over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$21.50
No. 16 cotton reinforced heavy		25.00
No. 18 cotton reinforced light		15.50
No. 16 cotton reinforced light		22.00
No. 18 cotton Canvasite cord		17.00
No. 16 cotton Canvasite cord		27.00
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$70.80	*76.70
No. 14 super service cord or similar (2 wire) in 1,000 ft.	106.20	*115.05

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100-amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 65%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1

REFILLS—

1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken cartons	Net list
Unbroken cartons	17%
Ten unbroken cartons	34%
Discount Without Contract—Renewals:	
Broken cartons	Net list
Unbroken cartons	17%
Ten unbroken cartons	34%
Discount With Contract—Fuses:	
Broken cartons	5%
Unbroken cartons	20%
Ten unbroken cartons	36%
Discount With Contract—Renewals:	
Broken cartons	Net list
Ten unbroken cartons	36%

Carton quantities may be combined to obtain maximum discounts.

FUSE PLUGS, MICA CAP—

0–30 ampere, standard package (500)	$2.80
0–30 ampere, less than standard package	3.10

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.20	...	....	.....
60	A 21	.20	...	....	.....
100	A 23	.35	...	....	.....

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f.o.b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$7.20	$9.90	$12.30	$20.50
12	10.90	12.69	15.50	27.00
10	14.85	16.85	20.40	36.15
8	22.05	24.80	27.10	51.00
6	.....	.....	39.50	.....
4	.....	.....	57.00	.....
2	.....	.....	79.50	.....
1	.....	.....	107.00	.....
0	.....	.....	132.00	.....
00	.....	.....	158.00	.....
000	.....	.....	193.00	.....
0000	.....	.....	235.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	½ In. or Pendant Cap Keyless	½ In. or Pendant Cap Pull	¾ In. Cap Key	¾ In. Cap Keyless	¾ In. Cap Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., in less than 100 lb., 31c. per lb.; in 100 lb. lots, 29c. per lb.
Rubber tape, ¾ in., in less than 100 lb., 33c. per lb.; in 100 lb. lots, 31c. per lb.
Wire solder, in less than 100 lb., 33c. per lb.; in 100 lb. lots, 31c. per lb.
Soldering paste, 2 oz. cans ..... $1.10 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c. or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25.00 to $50.00 list value	35%
$50.00 list value or over	40%